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THE BRISTOL CORPORATION AND ELECTRIC TRACTION.

SINCE the opening of the Bristol and Kingswood Electric Tramway over a year ago, the success of the line has been so remarkable both as regards cheap working and increase in traffic, and the population of Bristol has become so enthusiastic, that the Bristol Tramways and Carriage Company have applied to Parliament for powers to equip some 21 miles more of track on the overhead system, on which some 150 motor cars would be regularly operated. The Corporation of Bristol cannot purchase the greater part of the tramways for a period of some 20 years to come.

The Tramway Company have submitted their plans to the Corporation, and asked them to sanction the use of the trolley throughout Bristol and its neighbourhood.

The questions which the Corporation have to decide are, first, the desirability of introducing the trolley system throughout the City, and second, the terms to be imposed.

The Corporation appointed a Special Committee last March, composed of the Electrical and Sanitary Committees. This Special Committee called in Mr. W. H. Preece, Consulting Engineer to the Corporation when they erected their electric lighting works, to report upon the various methods of tramway traction, and as to the practicability and effect of supplying electrical power for traction from the works of the Corporation. To aid them still further the Special Committee, through the Town Clerk, procured information as to the use of electric traction on the tramways in other towns. The Special Committee then presented a report to the Corporation.

As to the first point, the desirability of introducing the trolley system, there seems to be no doubt in the Committee's mind that the Corporation should allow its general introduction throughout the city. They end the report as follows:—

"That the use of the overhead trolley system of electric traction may, on terms to be arranged, and for a period of five years, be allowed on the tramways in the city, except those in certain portions of the city to be hereafter defined by the Council, power being reserved to the Council to require at any time after the expiration of the said period, the substitution of any improved system which may have been found to be practicable, on giving 6 months' notice."

"That the extension of the use of the overhead trolley, or any other system of electric traction, on the tramways in the city be allowed, only on condition that the supply of electric current for working new electric tramways in the city be taken from the Corporation."

In arriving at these conclusions, the Committee mainly relies on the report of Mr. Preece.

It is to be regretted that Mr. Preece should not have first verified his statements, and that his report should be so made up as to appear, in many instances, contradictory, as, for

instance, attributing the success of American Tramway Companies to the "absence of legislative check or governmental control;" while also saying that "it is by no means clear that the operation of the Tramways Act has so far been beneficial. It certainly has retarded the introduction of tramways in this country, for, as a rule, we are behind other countries where no such legislation exists, particularly the United States, Sweden, and Germany." Yet Mr. Preece, in his opening statement, says that he proposes to show that the working, construction, and maintenance of tramways is a proper function of municipal authority.

Again, Mr. Preece says that "private enterprise builds lines solely for dividend, and only for districts which are likely to pay in their present conditions, while local authority would do so to benefit the ratepayers, to open up new districts and to provide convenient locomotion for those who are, perhaps, forcibly farther afield from their work." This is certainly not applicable to Bristol, where, as a matter of fact, the Tramway Company have not only built lines which are likely to pay, but have also pushed out into the country with a view to develop traffic and increase the value of property.

On the other hand, the Electric Lighting Committee has never ventured to supply current except where a profitable demand was fairly assured.

The Special Committee seems to have made a grave mistake in implying the possible use of some underground or conduit system, while their Engineer specially states that although the conduit can be worked and may at some future time become economically practical, it is not so yet, and that things must be considered as they are. Mr. Preece, when he argues in favour of the Corporation supplying the power, says:—"In Bristol, where the tramways were inaugurated by the Corporation, and where the Corporation may ultimately decide to absorb the tramways, it appears to me absurd to argue on the other side, for the Corporation could supply the current as cheap as the Company could produce it, and still make a profit, for it has the lighting business to relieve it of many of those fixed charges, modes of working, and items of expenditure, which the Tramway Company does not possess." We cannot understand this reasoning, and we fail to see why the Corporation, having built and unsuccessfully operated a few miles of track which they were glad to pass on to the Tramway Company, with the right to purchase in some 20 years, should assume to impose conditions on the Tramway Company as to the source from which they shall derive power.

The Committee claim that they can furnish power to the Tramway Company at a price which will be lower than that at which the Tramway Company can manufacture it itself, and they cite several instances where this is done. Unfortunately, all the cases cited are entirely inapplicable to Bristol, as the machinery in all the cases instanced has been specially designed, firstly for electric traction, and secondly for electric lighting, which is not the case in Bristol. Besides, it must be borne in mind that in most of the cases cited abroad, the Tramway Companies are dealing with private lighting companies, and not with Corporations, while in the present instance it must be remembered that the Corporation would occupy the anomalous position as servants of the Tramway Company in connection with its electrical supply, being at the same time the controlling authority of the city.

We cannot do better than quote a paragraph from the report of the consulting engineer to the Tramway Company Mr. Horace F. Parshall:—

"It cannot be too strongly impressed that there does not exist at the present time such an installation as Mr. Preece suggests as practicable for Bristol. His load diagrams seem to show that the maximum loads overlap, though as to this uniformity occurring I cannot agree with him, since the maximum load of the Tramway Company may or may not occur at the time suggested by Mr. Preece. The maximum loads occur on certain days, that is, holidays and Saturdays, and not at certain hours of any particular day. The two maximum loads may, however, occasionally happen at the same time. In tramway experience it has been found most economical to provide for these maxima by a proper margin in the generating machinery, and storage batteries in large systems are not considered economical or practicable."

Rome having been quoted as a successful example of the adaptation of alternating currents for the supply of electric tramway power and lighting combined, we would like to point out that as regards the efficiency of this system, no figures have ever been published, and the probabilities are that when compared to a direct system its efficiency would be from 30 per cent. to 40 per cent. lower, which, if true, would necessarily render the cost of production by the Corporation of Bristol much greater than if the Tramway Company had its own power station. In Rome there are at present only 10 cars running, and yet the weight of lead in the batteries is over 100 tons. Taking this as a basis of calculation for Bristol, we arrive at the stupendous result that over 1,500 tons of manufactured lead would be required in the batteries, the cost of which would probably much exceed £60,000.

We will again quote Mr. Parshall:—"First, with respect to Mr. Preece's load diagrams. The amount of power he proposes is altogether insufficient for the number of cars upon which he bases his calculations. Mr. Preece states your car stock at 100; as a fact, it is 124. He estimates it will be increased to 150, which I accept in my estimates of power required. Mr. Preece proceeds to state the daily average run per car at 70 miles, whereas, from your own experience at St. George, you know that not less than 100 miles is the regular practice. Again, for some inexplicable reason, Mr. Preece takes 300 days per annum, instead of the 365 known to tramway managers, the result being that his mileage for one car amounts to 21,000 miles per annum, as against 36,500, which is the fact, an error on Mr. Preece's part of no less than 75 per cent., which multiplied over the 150 cars, gives a similar mistake in the quantity of electricity to be consumed; so that instead of the 3,150,000 units per annum of Mr. Preece, you would require 5,475,000 units, even assuming for the moment that 1 unit per car mile would be adequate, having regard to the difficult gradients in Bristol. You will appreciate the magnitude of this miscalculation when I remind you that the error represents four times the total quantity generated last year by the Bristol Corporation Electricity Department."

Examining Mr. Preece's closing statement that he has demonstrated that the Lighting Committee can produce cur-

rent and supply to the Tramway Company cheaper than the latter can itself, we fail to find the proofs in support of this in his report. Our confidence is very much shaken by finding that in the few actual figures which he does quote he has almost invariably made serious mistakes. Furthermore, our opinion is borne out by the reports of such eminent men as Lord Kelvin and Dr. John Hopkinson, who both fully endorse Mr. Parshall's report to the Tramway Company, and who specifically state that in their opinion, under the particular circumstances obtaining in Bristol, the Corporation could not possibly supply current to the Tramway Company as cheaply as the latter could generate it for itself.

A contemporary has taken up the cudgels in favour of the Corporation, but unfortunately without considering the particular circumstances which obtain in Bristol, and it takes it for granted that because stations specially designed for electric traction such as Hamburg can supply light, a lighting station like that at Bristol, which was never designed for anything but lighting, can supply power for tramways. Our contemporary speaks lightly and airily of accumulators storing energy to supply the demand of a tramway when the latter overlaps the lighting demand, but without considering the enormous expenditure in accumulators which will be required. It furthermore states, that accumulators are employed in connection with the tramways at Hamburg, which is not true. The lighting and tramway plant are entirely separate at Hamburg, and accumulators are only used in connection with the lighting plant. Our contemporary further speaks of the supply of tramway current as a by-product. We would like to point out in this connection that what our contemporary calls a by-product amounts to nearly 10 times the present output of the lighting station, and we fail to see why the greater should suffer for the less.

There seems to be no reason why a Corporation electric lighting venture should be helped out at the expense of the general interests of the community, but the motto of the chairman of the Electric Lighting Committee of Bristol certainly seems to be that, even if the electric traction interests be destroyed, the Electric Lighting Committee must balance its annual budget at the expense of the Tramway Company and its shareholders.

Mr. Preece, in his report, says that even without any penalty clause, "the supply of energy by a Corporation is itself a guarantee of good service, for a Corporation, like a Government Department, works in the full glare of public light, and is eagerly supervised by an extremely critical and sensitive public, supported by a press ever ready to chronicle and pillory official laches." We have a good deal of belief in municipal bodies, but the municipal control of electrical matters will not be furthered very much if the Bristol Corporation persist in their present policy.

Telephone Relays.

Ever since telephony became a practical science, the idea of a telephone relay has been a favourite problem with numerous inventors. It may be questioned, however, whether these inventors have really grasped what is involved in the problem they have attempted to solve, and whether they have been working in anything more than an haphazard way. Let us consider what are the conditions involved, and whether, as matters stand now, there is any prospect of a successful telephone relay being devised. The conditions are very simple. We speak against a diaphragm on which is arranged a microphone, and this diaphragm vibrates with a certain intensity, an intensity which is perfectly perceptible, and which can be felt if the finger is held against it. The result of this vibration is to produce in the diaphragm of the telephone receiver at the further end of the line an effect which is certainly *not* perceptible to the touch. In other words, the receiver diaphragm vibrates with much less intensity than does the transmitter diaphragm; how then can a microphone arranged on this receiver diaphragm possibly cause a variation sufficient to retransmit, or to relay, along another section of line, equally long, say, with the first one. In order that i may do so, the receiver diaphragm, on which the microphone relay is arranged, must vibrate with the same intensity, or nearly so, as the original transmitter. Unless, therefore, the diaphragm of a receiver can be made to vibrate with an amplitude somewhat approaching that of the transmitter telephones relaying seems to be impracticable.

The Selection and Management of Employees.

A paper on this subject read before the American Street Railway Association at St. Louis by Mr. W. F. Kelly in October, endeavours to deal with the question of the tramway employee on the basis of his humanity. Mr. Kelly considers that the men who come into contact with the public ought to be far different from those, so numerous a class, who are always at variance with the public that really finds the sinews of war. An English cabman on the rampage, and asking "what d'ye call this," when he only receives his legal fare, is not a pleasant person to deal with, and American railway men, street car men, and policemen, number amongst them a very large proportion of the worst element of official insolence. Indeed, the stranger in America soon finds that the traditional liberty of America is liberty to be rude and overbearing if you happen to be an official, unless it be a postman. The American postman alone of all officials is a human being of whom we have pleasant recollections. Mr. Kelly considers that managers neglect the choice of suitable men as motor men, conductors, inspectors, or foremen—the classes of men who really make or mar a line, render it odious or otherwise to the public, have the collection of the company's income and perhaps the filching of part of it to their own personal use. He would avoid anarchists—why are there so many anarchists in America? and he condemns the choice of ex-policemen and firemen, or steam railroad employees, none of which objections would, we think, operate here. Friends of the directorate, needless to say, are undesirable, nor should the manager be biassed in favour of anyone. Mr. Kelly knows of a road where all the employees are of one religious belief, or, at least, profess to be; of another road where they are opposed to the same belief; of a third where foreign labour only is employed. With electrical working the old type of mule whacker of 20 years ago has disappeared, and the better educated men of to-day ought to receive a different class of treatment. He condemns suspensions as a punishment for minor offences, and is not surprised that a conductor thus perhaps heavily fined contrives to get even by nipping fares. The tramway service ought to be made a desirable service instead of being looked on as a sort of makeshift job which any man would pick up with a view to something better turning up. This question is one which will soon arise here when the apathy has departed which is at present retarding the development of electrical lines.

TRACTION DIAGRAMS.

By THOMAS TOMLINSON, B.E.

(*Continued from page* 459.)

In my last article, I gave a very convenient formula for the mean brake horse-power accounted for in the speed curve of a traction diagram; given the weight of the car, the coefficient of traction, and the grade; and applied it to a case in which particular care had been taken to measure these, and in which, further, the drawbar pulls corresponding to varying currents were given, so that it was possible to compare the values of the mean drawbar pull as required by the speed curve with the actual mean drawbar pull as estimated from the current curve, with satisfactory results.

The next set of curves, for which I have adequate data, are the curves of starts (figs. 22, 23, and 24) taken from a

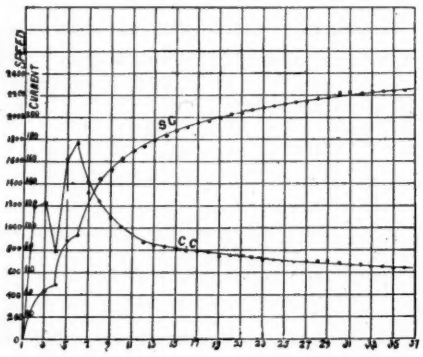


Fig. 22.

recent number of the *Street Railway Journal* (New York): they were taken by Messrs. Curtis and Pond, students of an American university, upon the Buffalo and Niagara Falls Railway.

The formula had better be repeated, as some time has elapsed since it was given: it is

$$\text{Mean brake horse-power (per ton)} = \frac{70\left(\frac{v_1 - v_0}{n}\right) \times \frac{v_1 + v_0}{2} + (p+q)v}{550}$$

where
v_0 = initial speed in feet per second,
v_1 = terminal " " " "
v = average " " " "
p = traction coefficient in lbs. per ton,
q = grade " " " " "
n = No. of seconds between v_0 and v_1,

the mechanical interpretation being that the product of mean drawbar pull necessary for acceleration by mean

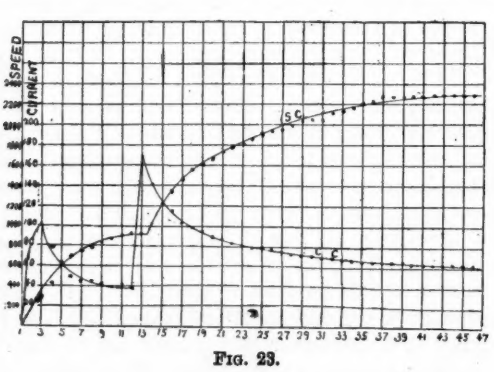


Fig. 23.

between initial and terminal speeds, plus the product of the sum of the drawbar pulls necessary to overcome friction and grade by the mean speed, represents the mean rate of doing work.

The diagrams are as given in figs. 22, 23, and 24: S C represents the speed curve; C C represents the current curve; the numbers along the base give the numbers of the observations taken at two seconds interval, so that each division represents 4 seconds interval. The speed scale shows feet per minute. The car experimented on had 28 feet body on double trucks, was 36 feet over all, and 8 feet wide, with seating capacity for 44 passengers, and weighed 30,515 lbs. (13·6 tons), it had a G.E. 800 motor on each of its four axles. The starts are made with motors two in series and two in parallel by means of a series-parallel controller.

The traction coefficient was found by running the car up to speed on a level and straight run, shutting off the current and observing the distance within which the car came to rest after current was shut off, and the speed at instant of shutting off current; the formula is:

$$f = \frac{1}{d} \times \frac{w\,v^2}{2\,g},$$

where
f = traction coefficient.
d = distance run.
w = weight of car.
v = velocity at time of breaking circuit.

This manner of estimating the traction coefficient includes obviously the mean resistance of the air between full speed and rest, indeed, the speed curves from breaking circuit to rest, of which several are given in the original article, show this, the curves showing that the speed falls at a more rapid rate at the start than at the close of the run.

The method already given in these articles—identical in theory—is better in practice because it measures the air resistance (included in the traction coefficient), as it is at or near full speed, and not as a mean from full speed to rest.

The resistance to traction of the car, as measured in the manner given above, was in three experiments 203·3 lbs., 207·7 lbs., and 210·5 lbs., or an average of, say, 207 lbs., giving a traction coefficient of 15·2 lbs. per ton.

The mechanical efficiency of the car on a straight level track is given as 63·37 per cent.

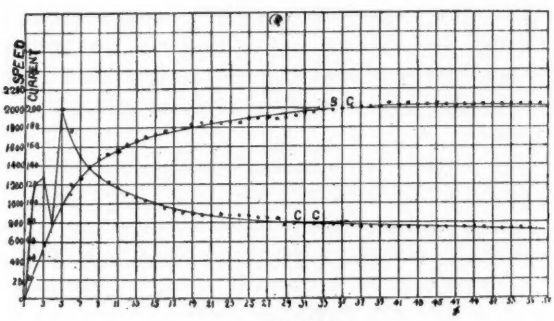


Fig. 24.

The starts figured in figs. 22, 23, and 24 seem to have been on a level—at least no mention is made of their being on a grade.

The mean pressure was 513 volts.

We are now in a position to calculate brake horse-power required, and electrical horse-power supplied. The times from rest to full speed are taken as 72, 80, and 80 seconds in the three diagrams, respectively.

The constant figures for all three diagrams are:

p = 15·2 lbs. per ton.
q = 0.
Pressure = 513 volts.
Weight = 13·6 tons.

The values of v_0, v_1, n, v, and C (mean current), as found from the diagrams, are best tabulated so:—

—	Fig. 22.	Fig. 23.	Fig. 24.
v_0	0	0	0
v_1	37·5	37·5	33·6
v	29·4	25·2	27·6
C	85·8	76·4	97·6
n	72	80	80

We first find the value of the factor $70\left(\frac{v - v_0}{n}\right)$ for each diagram, *i.e.*, the mean drawbar pull per ton to produce acceleration: the figures are 36·4, 32·8, and 29·4 lbs. respectively.

The resulting mean brake horse-powers per ton required by the speed curves are :—

B.H.P. (per ton) = 1·24 + 0·81 = 2·05 (fig. 22).
" " = 1·12 + 0 61 = 1·73 (fig. 23).
" " = 0·9 + 0·76 = 1·66 (fig. 24).

The quantities 1·24, 1·12, and 0·9 representing the mean brake horse-power required in each case for acceleration, and the quantities 0·81, 0·61, and 0·76 representing the mean brake horse-power required for friction (and wind pressure) in each case.

From the average currents, the constant pressure, 513 volts, and the weight, 13·6 tons, we can deduce the average E.H.P. per ton :

E.H.P. (per ton) = 4·33 (fig. 22)
" " " = 3·86 (fig. 23)
" " " = 4·93 (fig. 24)

whence we have

$$\text{efficiency} = \frac{\text{B.H.P.}}{\text{E.H.P.}} = 47 \text{ per cent. (fig. 22)}$$

" " = 45 " " (fig. 23)
" " = 34 " " (fig. 24).

The efficiency on a straight level track being 63·37 per cent., the loss of efficiency in starting varies from 16 per cent. to 29 per cent.—lost in resistance.

I can see no reason why the start in fig. 24 should give such a low result, or should disagree so markedly from the results got from figs. 23 and 24; possibly the runs represented by the latter were both in one direction down a slight grade, and the run represented by the former in the other direction up a slight grade—the grade being so slight as to be overlooked. A grade of 1 in 450, or 0·22 per cent., would make them all agree with a common efficiency of 40 per cent.

Another point about these diagrams is that the mechanical efficiency shown at the end of the run, when acceleration is over, does not by any means amount to the 63·37 per cent. claimed as the mechanical efficiency on a straight level track: it is 30 per cent. for figs. 22 and 23, and 25 per cent. for fig. 24.

This is one of the disadvantages of dealing with experiments at secondhand, if you find an anomaly you can only state it, you have no means of repeating a doubtful experiment, of verifying doubtful data, or of making fresh experiments to elucidate a doubtful point.

(*To be continued.*)

DESIGNING A BIPOLAR DRUM DYNAMO

By RANKIN KENNEDY.

(*Concluded from page* 485.)

In the first article there is a mistake in the proportion sum taken as an example as to the use of the table. The method is rightly shown, but the figures, 20, ought to be 23, the sum should be $\frac{15 \times 20}{23} = 13$; 13 inches being length for 15 unit armature.

Now let us further illustrate the armature winding rules. Take the 10 × 15 armature, which according to $n, a, d^2, 015$, gives 20 units; say the volts are to be 200, then $\frac{20{,}000}{200} = 100$ amperes, or 50 amperes in each conductor.

Then by rule 6 we find the flux total through armature,

$$11{\cdot}5 \times 15 \times 5 = 862{\cdot}5.$$

Then by rule 7 we find the number of wires counted all round the armature

$$\frac{200}{900 \times 862 \times {\cdot}000001} = 258$$

wires.

Refering to a wire table, we find No. 9 would carry the 50 amperes at 3,000 per square inch, or better still, a stranded wire of 37/·23: this would require to be wound on two layers.

258 is with 10 per cent. added, about 292; two turns per section will give us 4 wires per section on the periphery of the armature, and $\frac{292}{4} = 72$, the number of parts in the commutator taking an even number.

Thus, by these rules, we have all the details of the armature and also the magnetic flux.

We next pass on to find the particulars of the field magnet. It has to carry the total flux = 862 lines, plus leakage, allowing for which we may put down 1,000 lines total flux through the bobbins of the field magnets.

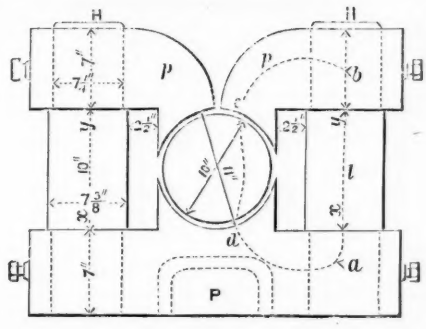


Fig. 2.

The design selected to illustrate the method of calculating field-magnets is chosen for several reasons: first, it is made up partly of cast-iron, and partly of soft wrought-iron, and, therefore, the treatment of both materials comes in; secondly, it is the best and simplest design for bipolar dynamos, ring or drum wound. It is far superior to the very common single magnetic circuit in over and undertype machines. It requires, however, to be more carefully calculated out and designed.

Fig. 2 is an elevation showing two soft annealed iron cores, H, H, two upper pole-pieces, *p*, *p*, and one under pole-piece, P, cast together with the pedestal seats.

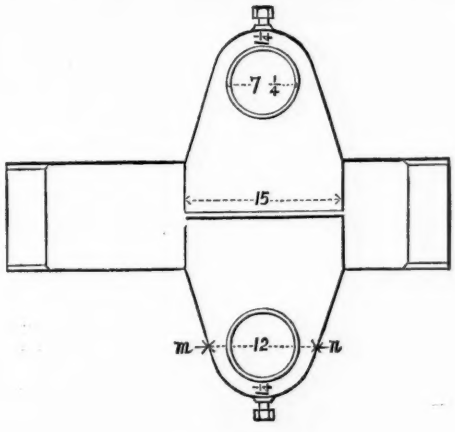


Fig. 3.

Fig. 3 is a plan showing the shape of the pole-pieces tapering out towards the centre. The breadth on line *m*, *n*, is important; this ought to be at least equal to half the circumference of the wrought-iron core, rule 8.

The total flux through the bobbins is to be 1,000, hence the flux through each core will be 500.

Now we find in practice that soft wrought-iron may be economically worked at a flux density of 12 lines per square inch, and it is a good rule.

9th rule, the flux density in the wrought-iron portion of an electro-magnet is to be 12 lines per square inch.

10th rule. The flux density in good cast-iron is to be six lines per square inch.

11th rule, 13·5 ampere turns are required to magnetise each inch of length in wrought-iron at a density of 12 lines per square inch.

12th rule, 28·5 ampere turns are required to magnetise each inch of length in cast-iron at a density of six lines per square inch.

In fig. 2 the line, *l*, gives us the lengths of the various materials. From *a* to *b* is the length of wrought-iron path; *b* to *c* plus *d* to *a*, the length of the cast-iron path; and *c* to *d*, the length of the armature path.

The rule 13th is to multiply the length of armature path, if it is a drum, by 10, to find ampere turns required to magnetise it.

14th rule. To find the ampere turns required to magnetise the air spaces, that is the distances between the surfaces of the poles and the surfaces of the armature, multiply the total air spaces lengths by 1,880, and by 5 (the flux density in the air space).

We now proceed to find the ampere turns required for each bobbin; but first, we must fix the length of the magnet cores. A good rule, 15th, for drum dynamos, is to make them from *x* to *y*, equal to the diameter of the armature, which in our case is 10 inches.

Rule 16th, the sectional area of the core is found by dividing the flux through it by 12.

Rule 17th. And the sectional area of the cast-iron is found by dividing the flux through it by 6. Sectional area of core $= \frac{500}{12}$, 42 nearly. Area, 42 inches, $= 7\frac{3}{8}$ inches diameter core.

Suppose the pole pieces solid cast-iron on line *m*, *n*, fig. 3.

Rule 18th, sectional area of pole on line, *m*, *n*, $= \frac{500}{6} = 84$ nearly, or double the section of the wrought-iron.

Now, from *m* to *n*, fig. 3, is to be equal to half the circumference of the core, which in this case will equal 12 inches, and now, if we divide 84, the sectional area, by 12, the breadth it will give us 7 inches as the depth from *y* to H, fig. 2.

To find the length of the air spaces we must take four No. 9 wires, each ·16 inch diameter, therefore equal to 0·64 inches, to this must be added 0·2 for clearance, and 0·1 for insulation, giving a total very nearly equal to 1 inch.

The average length through the armature is about 7 inches from *c* to *d*.

The length of the wrought-iron circuit from *a* to *b* will be obviously 17 inches. The length of the cast-iron will measure from *b* to *c* and from *d* to *a* 9 inches each, 18 inches in all.

Now we have all the sizes of the field-magnet, the lengths, breadths, depths, diameters, and sections, we have only to calculate ampere turns for bobbins.

Wrought-iron, 17 × 13·5	=	229·5
Cast-iron, 18 × 28·5	=	513
Air spaces, 1,880 × 1 × 5	=	9,400
Armature, 7 × 10	=	70
Total ampere turns on each bobbin		10,212·5

Three amperes or 3 per cent. of the total current is a good average exciting current, hence if we divide the total ampere turns by 3, we will find the number of turns on each bobbin $\frac{10,212·5}{3} = 3,071$ turns of wire.

Shunt bobbins on dynamos are worked at a density of 1,000 amperes per square inch section, hence we find a No. 16 S.W.G. wire will be ample in size. The two bobbins in series will require to have a resistance of 66 ohms, each will then have 33 ohms.

No. 16 has 7·6 ohms per 1,000 yards $\frac{33}{7·6} = 4,342$ yards, or 130,260 feet in each coil, the coils would average 2·5 feet in length, so that

$$\frac{130,260}{2·5} = 6,020 \text{ turns},$$

just about double what we require.

We must try No 17 at 2 amperes; each bobbin would then require to be 50 ohms and the turns equal to

$$\frac{10,212}{2} - 5,106.$$

5,106 × 2 5 the average length of a turn = 4,255 yards. And as No. 17 is 10 ohms per thousand yards we will get 42·5 ohms in the exact number of turns, 4,500 yards would probably be enough as the resistance is greater when hot and a regulating shunt resistance is usually included. No. 17 weighs about 28 lbs. per 1,000 yards, hence we require 28 × 4·5 lbs. for each bobbin = 126 lbs. each. This method of trial and error is the only way to arrive at the winding which will meet both requirements, namely, the number of turns and the resistance, and also keep to the rule not to exceed 1,000 amperes per square inch of current density.

It is not necessary in these papers to go further into the design, the object is merely to show the order of the procedure in designing, and to give numerical rules for calculating dimensions of parts, questions regarding which are continually being asked by students, amateurs, &c.

The process is a step by step one, based on practical experience, and gives excellent results.

In calculating the table, instead of taking N, *a*, d^2 015, we might take N, *a*, d^2 010, and thereby we will produce superior machines, for the output will be less for same weight.

The method is the only one whereby the total magnetic flux is determined rationally, and which gives the designer the proper starting points to begin with.

For every particular regarding wires of all kinds for dynamos, and full tables, Messrs. Glover issue a small very useful book.

In a Gramme ring armature machine by Mather & Platt, giving 22,000 watts output, $n = 1,050$, $a = 12$, $d^2 = 144$,

$$1,050 \times 12 \times 144 = 1,814,400,$$

and $\frac{22,000}{1,814,400}$ gives 0·0121

for the multiplier instead of 0·015 as used for the drum armatures in the table given; 0·015 is the highest multiplier to be used in calculating the output of drum armatures, but in cases where machines are required with a high margin of safety, to work very cool at full load and sparkless, 0·01 must be used as the multiplier for drums.

Higher speed may also be chosen. Those who wish to apply the method will decide for themselves the peripheral speed, also what multiplier to use in constructing the table.

THE PIONEER TRANSMISSION PLANT, OGDEN, UTAH.*

The Pioneer Electric Power Company, of Ogden, Utah, in September placed a contract with the General Electric Company for a complete 5,000 horse-power, three-phase plant, covering a transmission of 36 miles, from Ogden to Salt Lake City.

The power will be obtained from the fall in the canon of the Ogden River, at a point almost within the limits of the City of Ogden. Across the head of the Ogden Canon a dam is to be thrown, and an immense storage reservoir formed, which will cover some 15 or 20 square miles of a valley in the mountains. From this dam to the power house is a distance of nearly six miles. The water will be carried through a six-foot pipe of wood for about five miles, while for the rest of the way it will pass through a six-foot pipe of riveted steel. These pipes are fitted at intervals with automatic relief and air valves to prevent the bursting or collapsing when the flow of water is varied by changes of load. The effective head of water at the power house will vary from 400 to 450 feet and the full capacity of the pipe line will be 10,000 horse-power.

Two duplicate receivers will be used, one at each side of the power house so that either can be shut down without stopping the plant. To these the pipes running to the water wheel nozzles will be connected. The speed of the wheels

* New York *Electrical Engineer*.

will be controlled by Knight governors and the valves will be operated by hydraulic pistons so that the generators may be stopped and started from the switchboard. The water from the wheels on each side of the power house will pass into a central tail race under the floor between the two lines of generators, and will be conveyed into canals for the irrigation of some 18,000 acres of land in the vicinity of Ogden, which will be reclaimed for farming purposes.

The electric plant at first will consist of five 1,000-horse-power 24-pole, three-phase generators, driven by Knight water-wheels running at 300 revolutions per minute. The water-wheels and fittings will be furnished by the Risdon Iron and Locomotive Works, of San Francisco. Water-wheel and armature are mounted on the same shaft, and are supported by the same base frame and bearings. The periodicity of the current is 60 cycles per second and the generators will be wound for 2,300 volts. The exciters, each of 100 kilowatt capacity, direct connected to their own water-wheels will be provided, either of which will suffice to excite the fields of all the generators in the completed station. The current from the generators will be carried by lead-covered cables laid in ducts between the generator foundations and the wall of the building, to the generator switchboards at one end of the power house. The boards will be blue Vermont marble panels and will be completely equipped with all the necessary controlling and regulating instruments and apparatus. Tachometers on the switchboard, operated by synchronous motors electrically connected to the generators will indicate the speed of the machines.

The step-up transformers and the 2,000 and 15,000 volt feeder panels will be placed in a gallery erected over the generator switchboard. The transformers, nine in number, each of 250 kilowatt capacity, will raise the generator potential from 2,300 volts to 15,000 volts, at which pressure 2,000 horse-power will be transmitted to Salt Lake City. The local distribution of the balance at Ogden will be made at 2,300 volts.

The transmitted current will pass over six No. 1 wires strung on insulators of a special porcelain developed by the General Electric Company, to withstand high potentials, and be delivered to nine 250-kilowatt, step-down transformers at Salt Lake City, which will connect it at 2,300 volts for distribution.

The transmission line and transformers will be arranged to allow of the use of a potential of 25,000 volts. This will permit of the efficient transmission of current to the mining regions of Mercur and other camps 30 to 35 miles beyond Salt Lake City. All lines will be protected by the latest types of General Electric lightning arresters, which have proved so efficient in other transmissions.

To construct the iron and wooden pipe bringing the water to the wheels, motors of 100 horse-power are set up in the shops of Rhodes Brothers, in Ogden, supplying extra power for the work, which is one of the most extensive pipe line contracts ever undertaken, 5 miles of 6-foot wooden stave pipe, and 1 mile of 6-foot riveted steel pipe. Practically, all the work will be done on the ground, the steel being received in flat sheets to be rolled, punched and riveted in the shops, and lumber for the wooden pipe in the rough to be milled, planed and put together on the spot.

Salt Lake City, with the completion of the Pioneer plant, will receive power from two of the most important electrical transmission installations ever undertaken. That transmitting the power from the Big Cottonwood Canon, already described in the *Electrical Engineer*, has only recently been completed, that of the Pioneer Company will probably be inaugurated about November 1st of this year.

A LIGHT RAILWAY.

In view of the small results that have so far followed the passing of the Light Railways Act, a new line recently constructed for the Duke of Westminster at Eaton Hall, by Mr. Percival Heywood, may be of interest. One end of the line is in the Park, the other three miles away at Balderton, a station on the Great Western system. The gauge is only 15 inches, and the line is 3 miles long, or with several little branches, and one to Pulford of $\frac{3}{4}$ mile long, a total of $4\frac{1}{2}$ miles. The cost of the earth works on this line has been £205 per mile, and the total cost £1,095 per mile. The rails are of flat-bottomed section, weigh $16\frac{1}{2}$ lbs. per yard, and the sleepers are of cast-iron and weigh 28 lbs. each, and are spaced 27 inches C. to C., except at rail joints, where the spacing is 16 inches. They measure 36 inches × $6\frac{1}{2}$ inches, and the rails are secured by steel spring keys in lugs cast on the sleeper. The sleepers rest on ballast of furnace cinder 6 inches deep. The line is a surface line, and the longest bridge is 28 feet span. All bridges are of steel girders with cast-iron bed-plates. The ruling gradient is 1—70, and the sharpest curve is $4\frac{1}{2}$ chains radius, except on branches where the radius of some curves is barely 1 chain (60 feet).

As the line is estimated to carry about 5,000 tons per year, the rolling stock is not heavy. It cost only £214, and consists of one 3-ton engine, with wheels of 15 inches diameter and cylinders $4\frac{3}{8}$ inches × 7 inches, working at a pressure of 160 lbs. It is estimated that the coal per day will not exceed 2 cwt., and that the engine will draw a load of 40 tons on a level, or 20 tons up the 1 in 70 gradient at a speed of 10 miles per hour. There are 30 waggons of $7\frac{1}{2}$ cwt., each suitable for carrying 15 cwt. of coal, or a ton of brick or stone. They measure 6 feet × 3 feet × 1 foot 3 inches, and are convertible to the plain platform type for carrying large stones in block or timber. A passenger car, 20 feet × $3\frac{1}{2}$ feet × 23 cwt., to seat 16 passengers, and a 2 tons capacity parcel van, a brake van, and a couple of 2 tons capacity waggons, complete the equipment in vehicles, so that, including rolling stock, the cost comes to £1,309 per mile, and the annual interest at 4 per cent. on the whole is £235, to which, adding £80 for renewal at 4 per cent. per annum of the permanent way, and 8 per cent. for rolling stock, estimated to have a life of $12\frac{1}{2}$ years, we get the total of £387 capital charge. Working expenses are £255, and include £91 for engine driver, £99 for two platelayers, £26 for brake boy, and £39 for fuel and oil. The total annual expense is £642, and if the average haul is $2\frac{1}{2}$ miles, the cost per ton mile is seen to be 1s. per ton mile for 5,000 tons per annum. Our contemporary, *Engineering*, to whom we are indebted for the figures, states the capacity to be 10,000 tons per annum. If this load can be secured, the cost will thus be only 6d. per ton mile.

In either case the cost would be less than cartage, and it remains to be seen how this little line behaves itself, and whether it secures the modest 10 tons a week that is estimated. There is in addition such passenger traffic as it is likely to secure. We need scarcely point out how easily small lines like this could be electrically worked, especially when at one end there is a large house with electrical plant, and therefore a prospect of low cost motive power. Such a combination, with a bank of accumulators, could very well be arranged. Several similar sites suggest themselves to us as we write where the railway is three to six miles distant, and yet there are village populations to be served both terminally and *en route*.

In many respects, if properly undertaken, the application of electric light to country villages would be far simpler than its application in London. The villages so often belong entirely to one big house, that one central station could easily light all the place and work the light railway, as well as provide all other power in the village. Such light lines are only to be thought of where there is no serious prospect of the future growth of the village. To have a double gauge in any country is very apt to prove a misfortune, and the extension of narrow gauges is not to be thoughtlessly entered upon.

REFUSE DESTRUCTORS AND ELECTRIC LIGHTING.

We have before us a report upon a combined electric lighting and refuse destructor scheme presented to the Fulham Vestry by Mr. Francis H. Medhurst, B.Sc., M.Inst.E.E., consulting engineer to the Vestry.

The general lines of the report will be understood from this sentence "It has, I think, been very clearly demonstrated that a refuse destructor is, alike on sanitary and economic grounds, an absolute necessity at Fulham. But if it can, by being combined with other municipal works, have the latter (viz., the economic) attribute emphasised without

the least detriment to its primary qualification as an essentially sanitary apparatus, then no one could reasonably object to such a highly desirable consummation."

The engineer first deals with the question of the destructors.

The present cost of barging away the refuse is 2s. 3d. per load, the estimated cost of destruction is safely taken at 1s. per load, and the difference of 1s. 3d. per load upon an annual collection of 22,000 loads shows a saving of £1,375 per annum: the 14 cells recommended with chimney shaft and buildings are estimated to cost £12,800, and, deducting from the gross profit interest and sinking fund at the rate of 5 per cent., there remains a net saving of £735 per annum by burning the refuse instead of barging it away.

It is further proposed to erect a disinfector heated by the waste heat of the destructors, thereby saving the difference between the annual cost of disinfection as at present carried out, and the estimated annual cost on the proposed plan: this saving is estimated at £227 per annum.

This gives a total annual saving of £962 on the destructor and disinfector part of the scheme, and justifies financially works that are desirable from a sanitary point of view.

The electric lighting part of the scheme is on the basis of a lamp connection of 14,000 8-C.P. lamps and 68 arcs for public lighting. It is proposed to provide steam and electric plant of 450 kw. capacity, costing, with the requisite buildings, £41,700, of which £20,700 is for plant, £16,000 for mains and arc lighting, and £5,000 for buildings and contingencies.

The system proposed is H.T. alternating with sub-stations, the arc lights being supplied with rectified currents from the alternators.

The engineer in one sentence seems to anticipate a greater saving in coal from the utilisation of the waste heat of the destructors than we think he is likely to obtain. That, however, is a matter of opinion, and he has wisely guarded his scheme against the results of any failure of the destructors to fulfil his expectations by taking the total estimated cost of production at 2½d. per unit. This is not lower than may reasonably be expected in the case of a well-managed municipal station with sub-station distribution, and with a large proportion of its output for public all-night lighting run from the ordinary alternators, and which has also the advantage of dividing a fair proportion of its charges with other municipal undertakings under the same roof.

It is clear that the assembling of municipal enterprises as far as possible under one roof and under one engineering control, both for erection and running, must lead to considerable economies in the first cost and running charges of the schemes, and where a clear saving in expense can be shown in the disposal of the refuse in destructors, then by undertaking the two enterprises, electric lighting and refuse destruction at the same time, there is this added gain, that during the first year of operation the saving upon the destructor part of the scheme, which comes into effect at once, covers, or nearly covers, the inevitable initial loss upon the electric lighting part of the scheme while its lamp connection is creeping up to the paying point.

THE BRITISH MOTOR SYNDICATE.

The outcry raised by certain of the so-called patentees against the use of their names in the impudent puffing of the above Syndicate's attempt to extract three millions from the public pocket, has called forth a letter from the secretary of the Syndicate which had been best left unwritten. This ingenious assistant-secretary as he describes himself, calls £12,000 a very substantial sum of money to have paid to Messrs. Holt and Beaumont for their respective patents. We do not quarrel with the sum. It may be a fair equivalent for the patents or it may not, but on the face of it, as these two gentlemen are put in the forefront of the great list of patentees, we can only conclude that they are the chief reliance of the Syndicate, and hence we can only say that they have been very moderate in getting only £12,000 for patents which form the corner stone of a demand for £3,000,000.

It must either be that the two gentlemen have been as babes in the hands of the Syndicate, or that the Syndicate is blessed with a brazen conscience, or lack of it. "An Old and Experienced Engineer" writes to the *Times*, and points out the utter absurdity of the Syndicate's claim to control any master patents. The Otto cycle engine was a master patent. It was one of the few that have been taken out during the past 20 years. The Syndicate either do not understand the meaning of a master patent, or they misapply the term. What is there in common between the hash up owned or exploited by the Syndicate, and such properties as the Otto patent, the incandescent light, or the Bessemer process? Simply nothing.

It cannot be too seriously impressed upon everyone that there are no motor patents of such value that anyone need go to the expense of using them, for other motors can be obtained of equal worth. Any patents relating to motor vehicles are for minor points, such as safety appliances to prevent accidents, or improved carburetors, accumulator cells, and similar details. We do not believe any intending maker of a motor car will either desire or need to go to the British Motor Syndicate with a single penny to purchase rights of any sort, or if he did go, that he could lay out his penny, or other coins, to place himself at an advantage above the open market. Our own advice to intending makers of motor cars has been to go ahead, get cars on the market, take no heed to patents, but get cars on sale. We believe, and have done from the first, that there are practicable cars to be bought to-day, but we doubt if in a few years time the cars of to-day will be in any better position than the old iron-tyred wooden bicycle. Yet the makers of the defunct boneshaker are the makers of the modern pneumatic. The trade has been continuous. The firm which built the "Rocket" is building locomotives to-day in Newcastle. Henry Booth, the treasurer of the Liverpool and Manchester Railway, received part of the premium of £500 for his invention of the tubular boiler which formed part of the successful "Rocket," and was credited with the success really due to the steam blast. The principle was right, but as there were only 25 tubes of 3 inches diameter, the practice was, perhaps, not very good. As compared with any motor car, the "Rocket" was a mass of novelty, but though the tubular boiler was believed to have been a large factor in the success of the "Rocket," very little was paid for it. Millions are asked to-day for the veriest trifles, and indeed the prospectus of the British Motor Syndicate did not even deign to state what patents had been secured. There was merely a list of names of men who, in some instances, were tacked on to the names of patents now expired. Thus Mr. Holt was tacked on to the Otto patent in a manner to lead the uninstructed to think the Syndicate were the possessors of the Otto patent, of which many of the uninstructed have heard much, yet know so little. Apart from the request for millions, the prospectus had thus a very misleading appearance, for many who might become subscribers would be unaware that the Otto patent had lapsed.

THE NIAGARA-NEW YORK POWER TRANSMISSION AT THE ELECTRICAL EXPOSITION.

The report of the nineteenth convention of the National Electric Light Association has just been issued by Secretary Geo. F. Porter, and presents a handsome appearance. Besides containing in full the papers read before the Association at its last meeting in May, together with complete illustrations, it gives an excellent *résumé* of the salient features of the late Electrical Exposition, including the official reports of the companies engaged in the telephonic transmission of the roar of Niagara; of the companies over whose wires messages were sent around the earth; and the report of the transmission of power from Niagara to New York for the operation of the model of the great Niagara power plant. Among the latter is the report of Mr. L. B. Stillwell, electrical engineer and assistant manager of the Westinghouse Company, which contains some details of this

remarkable work not, says the N. Y. *Electrical Engineer*, heretofore published. Mr. Stillwell's report is given in abstract below:

The energy was transmitted by three-phase alternating currents; two of the conductors of the three-wire circuit were telegraph wires furnished by the Western Union Telegraph Company; the third was the earth, through ground connections in the power house at Niagara and in the Exposition building, New York City.

At Niagara, two-phase current at a frequency of 25 cycles per second and a potential approximating 2,200 volts was obtained from one of the 5,000 horse power generators of the Niagara Falls Power Company.

Two small transformers, connected in the manner devised by Mr. Chas. F. Scott, and first described by him in his paper read before the annual convention of the National Electric Light Association, in Washington, D. C., March 1st, 1894, received the two-phase current and delivered to the transmitting circuits three-phase current. The potential delivered by these transformers, when supplied with a current at 2,200 volts, namely, 450 volts, was found to be rather low for good results, and the potential delivered to the line at Niagara was therefore increased to 500 volts by the use of two small transformers, connected as Stillwell regulators, in each side of the two-phase primary circuit.

The transformers at the New York end of the line were of the dimensions of the standard three-kilowatt Westinghouse transformer, but they were designed to deliver only 14 watts each, and the energy required to magnetise the iron core was less than one and one-half watts. The energy lost in the copper, when the transformer was delivering 14 watts, amounted to only one-quarter of one watt.

By actual test, the energy required to drive the motor was 8 watts. The clearance between armature and field was one-fiftieth of an inch. No very accurate measurement of the power developed was taken, but when the line was in favourable condition, that is, when the weather was dry and the leakage consequently low, the power developed was probably about one-thirtieth of one horse power. The motor was of the induction type and wound for two-phase currents. The electrical specifications for this motor were made out by Mr. B. G. Lamme.

The specifications for the transformers were made out by Mr. J. B. Whitehead, under the immediate supervision of Mr. Chas. F. Scott, the electrician of the Westinghouse Company.

Referring to the diagram, G is the 5,000 horse-power, two-phase generator; R and R′, the regulating transformers; T and T′, the two-phase, three-phase transformers at Niagara; L, the line or transmitting circuit; T″ and T‴ the three-phase, two-phase transformers in New York; and M, the motor.

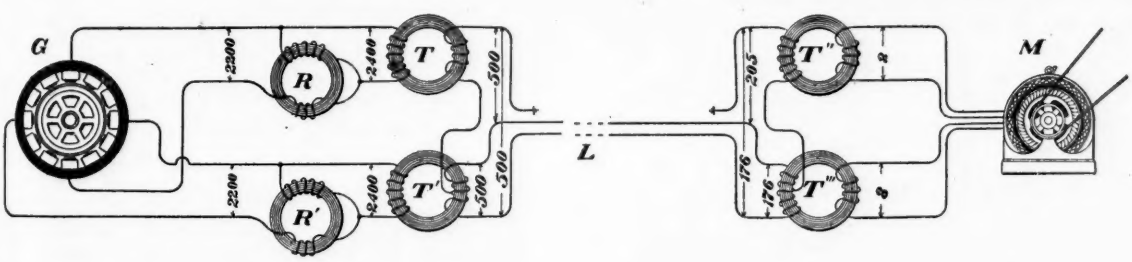
The potentials given in the diagram are closely approximate for the Niagara end of the line; for the New York end of the line they roughly represent what may be called the average conditions of operation.

The potential of the currents delivered at the New York end of the line varied between rather wide limits, from one night to another, depending apparently to a very considerable extent upon the leakage from the line, as influenced by atmospheric conditions. The alternating current motor was operated satisfactorily, potentials at the New York end of the line increasing when the motor was connected to the circuits. This effect was probably due to capacity of the circuits being counteracted by inductance when the motor and step-down transformers are connected; the current then more nearly coinciding in phase with the impressed electromotive force.

INSTALLATION TESTING.

By V. ZINGLER, A.I.E.E.

The object of these notes is to provide, for those who are in charge of installation work, a methodical way of testing for and tracing out or locating faults, earths, or short circuits; and also to give probable causes of same, and to suggest precautions or remedies to be taken to guard against their occurrence or recurrence. In few cases of installation work is there a man in control who has a good theoretical knowledge of electricity, or, failing that, of scientific and methodical testing. The student fresh from college knows all about the Wheatstone bridge, and can explain it to you mathematically, but has no practical knowledge of fault finding, which will save his firm many pounds sterling in time. The foreman who has served his time as wireman-joiner knows all about turning the handle of a generator and reading off "Infinity" on the ohmmeter by taking the circuits singly instead of bunched; he also has usually some methods of his own for locating faults, which arrive at the right result in the end, but after unnecessary labour. But neither the students nor the foremen have the head for looking at the subject logically, and employing a method of elimination which will bring them to the desired result, with the minimum of time and labour. Indeed, they so often lose their heads, that the finishing up of an installation frequently costs a big percentage of the total cost—time spent in locating faults before calling in the supply company being a big item. The following remarks contain nothing new, but may assist those employed on this kind of work, by enabling them to be methodical in their way of testing, and by the exercise of a certain amount of gumption, to look ahead sufficiently to locate a fault as much by reasoning as by turning a handle.



In the first place it is necessary to assume a given condition of things, and perhaps it is best to take an average two-wire distribution board system, having double pole cut-out and switch; mains to main distributing switch and fuse board; thence sub-mains to distributing fuse-boards on different floors, and thence circuits, each controlling not more than six or seven 16-C.P. lamps.

This is the simplest condition of things, and all other systems of wiring may be said to be special cases, to which the same form of elimination in testing may be applied, with a little more thought.

We will assume that the condition of the installation is such that the supply company are about to be called in to make their inspection and turn on the light, and that the man in charge has made a general test first—with the result that a serious fault is apparent. The question now is to arrive at this fault in the quickest possible way.

In the first place it is necessary to be sure that in finding one fault you are not neglecting another; therefore it is best to go over the whole building, turning on all main and point switches; examining all fuses, seeing that all lamps are in and all plugs connected up to portable lamps; switching on all key-sockets, and if any fittings or switches are not fixed, twisting the wires together, after being sure that the braid is stripped back at least an inch, and that the wires are not making "earth."

Testing Main Switch.

Now, with a piece of fuse or binding wire connect the two main fuses together and test in the usual way, attaching the line wire to the two fuses.

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Now break the main switch. If the fault is still apparent, it is obvious that there is an "earth" on the main switch, and the same should be taken down and examined. The causes for this may be bad or metallic marble or slate, dampness, or a contact to earth at the back. In the latter case, the remedy is obvious; in the former cases, the conductivity of the slate has probably carried the current through the fixing screws into the grounds, and thence to earth. The only remedy here is to bush the fixing screws well with ebonite. (It may be well to note here that if the test is being made at a period subsequent to the turning on of the light, the "earth" is very probably caused by leakage over the slate to the company's mains, where there is always an "earth." In this case, the only fair way to test is to completely disconnect the main switch from the mains.)

If, however, on switching off the main switch the fault goes off, or even after the main switch has been taken down, there still also remains a fault in the building, the next thing is to turn off all the switches on the distribution switchboard, so that only the mains are to be tested. These switches should be turned off one by one, and if the fault is still apparent, it is clear that it lies between the main switch and the distributing switchboard.

Testing Mains.

The only thing to do now is to disconnect the mains at each end and completely free them, seeing that there is no damp braid at either end likely to conduct to the sockets. Test these mains first together and then singly. If the fault is still there, the only thing is to locate the place by cutting, or if in the pipe system, by drawing out. These remedies will be treated later on.

If the fault is not discovered in the mains, it is then evidently due to an earth on the distributing switchboard, or—what is the same thing—conductivity across the slate to a faulty circuit and thence to earth.

Testing Switchboards.

The thing to do now is to test the main distributing switchboard. For this purpose take out all the sub-main leads from their terminals and free them entirely from the board. Now, with a piece of binding wire, connect every bus bar and socket possible, turning on all the switches at the same time, so as to get the greatest surface over the whole slab or slabs. As the wires are all disconnected, any fault will now be due to insufficient insulation to earth, and the same course should be adopted as with the main switch. If, on the other hand, the insulation to earth is perfect, it is evident that the fault which was apparent before the sub-main wires were disconnected is due to surface or metallic vein leakage over the slabs to a faulty circuit. In this case the best thing to do with the switchboard is to let it alone, if the conductivity is not very great; or, if all the contacts are on one slab, so that there is a difference of potential across the marble or slate, it is best to bush one set of contacts.

Having now got as far as the main switchboard (and here it may be mentioned that it is best, if the fault we are searching for is serious, to leave everything behind dismantled, and take the testing instruments from point to point, gradually narrowing the network under test; because in re-connecting leads which have been freed, it is possible to make a new "earth," which will upset the test, although all these things can be made good by a man following in the wake of the tester), and not located the fault, we now start on the sub-mains.

Testing Sub-Mains.

In the first place, to be quite sure of our position, it is best to bind the ends of all these mains together, and test again, because the fault may have been due to one of the sockets, when bolted to the switchboard, actually touching the grounds or wall, and thus making "earth." If this is the case, the reason of the fault now being "off" will be clear.

If the fault is still on, take the circuits one by one, two wires bound together, and the faulty circuit or circuits will soon be located. It now remains to be seen whether the fault is on the sub-mains, to the circuit or floor fuse-boards, or beyond. For this purpose, disconnect the sub-mains under test from the fuse-board, and test in the same way as when testing the mains from the main switch. If the fault is still on, these sub-mains being free at each end, test each one singly and locate the fault as in the mains.

Testing Fuse-boards.

If, however, the fault disappears, it is obviously on the fuse-board or circuits. For this, it is only necessary to carry out the same course of testing as on the main switchboard, disconnecting first the circuits, and testing the slab for earth or conductivity.

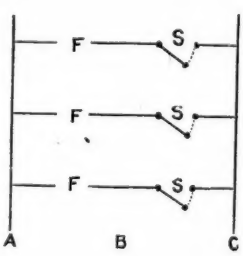
Testing Circuits.

We have now got over the greater part of the ground, but the remaining part requires more care.

After locating our circuit in the same way as at the main switchboard, we are presented with several probable causes for an "earth." There may be "earth" through wire, fittings, holders, lamps, switches, or plugs.

The first thing to do now is to take out all the lamps. This must be done for two reasons, *i.e.* (1) if the fault is in the lamps it will now disappear; (2) if it is not in the lamps it will be located to one side of the fittings or the other (or, as usually termed, to one pole).

For convenience sake, we will assume that all point switches are tapped off the same main, which is, indeed, the correct thing to do. Then our condition of things is as indicated by the figure, F being fittings or plugs, S being switches, A and C being circuit leads, with tappings to fittings and switches respectively, and B being wires between switches and fittings.



After having taken out the lamps one by one, noticing the instrument all the while, any lamps which are badly insulated between terminals and collar, and so caused a fault through a badly-insulated fitting, will have been discovered and thrown out. If the fault is still on, or only partially removed, now test the circuit wires, A and C (at the fuse-board end, as before), singly. We will assume the fault is on the side, C. Turn off all the point switches. If the fault goes off, it will be found on the B side of the switches. If it does not go off, it is either a fault in the C side, or an earth on one of the switches. In order to locate this, take off the switches one by one; first, simply drawing out the fixing screws and then disconnecting the switches entirely, leaving the ends free. If the fault goes off now, it will be found to be due to a switch being screwed on to a damp ground, or, perhaps, touching a gas pipe. In the pipe system these faults are frequently found if care is not taken. On the other hand, if the fault is not in the switches, and does not go off, it is in the C circuit wire or tappings, and must be found by cutting.

(To be continued.)

ELECTRIC AUTOMOTORS.

By DESMOND G. FITZ-GERALD.

In the clever story by Sir Walter Besant and Mr. James Rice, entitled "The Seamy Side," the following strictures on a certain class of company promoter appear:—

"They consider nothing about a company except to inquire how the idea can be so presented as to attract the general public. Whether it is a snare and a delusion, whether the formation of such a company is a dishonest trading on the credulity of the ignorant, whether the traffic in its shares is

not a mere robbery and plunder—these are things which the small projectors neither inquire into nor care for, nor would understand."

To what extent, if at all, these strictures may be applicable to the schemes put forward for supplying London with electrical cabs and other vehicles is a question which will obtain a solution in the near future, but which for the present must be left for the consideration of those who are best able to judge of the matter, and whose interests are most involved in it. For my own part, foreseeing what was coming, I made my protest beforehand—a portion of which, in a condensed form, may be found at the commencement of the second column of p. 437 in your last volume.

Leaving out of consideration those secondary batteries which are almost or quite unknown to the electrical public, although more than one are in advance of anything that has been largely advertised, let us investigate what can be effected, in the way of traction, by a modern accumulator, specially designed for traction, which has confidently been put forward by a firm which cannot afford to—and would not if it could—ignore its responsibilites. I will assume, though I have not personally tested the fact, that what has been put forward on its behalf can be practically substantiated.

According to the values given by the manufacturers, 1 ton of Faure-King cells would yield about $2{,}240 \times 4{\cdot}5 = 10{,}000$ ampere-hours, which, at 1·9 *v.* = over 25 H.P.-hours electrical.

Allowing efficiences of 80 per cent. for the gearing, and 80 per cent. for the motor, we get a total efficiency of 64 per cent. for the conversion of electrical into mechanical energy. The latter will be:—

$$25 \times \frac{64}{100} = 16 \text{ H.P.-hours mechanical.}$$

Let us suppose that the accumulator has to transport itself, by means of a carriage and motor, imponderable, but otherwise subject to the ordinary conditions, at the rate of 7 miles per hour on a good level road.

Then, let $\frac{L}{t}$ = the speed in miles per minute = ·117, and

$$n = \frac{\text{lbs. in 1 ton}}{\text{resistance per ton}} = \frac{2{,}240}{70 \text{ lb.}} = 30.$$

(f or K = 70 lb. = traction per ton).

Then the H.P. required to draw the ton weight at the given speed will be

$$\text{H.P.} = \frac{{\cdot}117 \times 358}{30} = 1{\cdot}4.$$

Our 16 H.P. hours will afford this power during the time,

$$\frac{16}{1{\cdot}4} = 11{\cdot}4 \text{ hours.}$$

And the distance through which any weight of the accumulator could transport itself under the conditions specified is

$$11{\cdot}4 \times 7 = 80 \text{ miles.}$$

$$\text{H.P.} = \frac{\text{W K S}}{33{,}000} \pm \frac{\text{W . S . } 2{,}240}{33{,}000} \times \sin \alpha.$$

Taking Mr. A. T. Snell's formula, in which S is speed in feet per minute, we have

$$\text{H.P.} = \frac{70 \times 616}{33{,}000} = 1{\cdot}30,$$

making the distance a little greater.

In an ordinary cab, the weight of two persons *plus* that of the driver may be taken as 460 lbs. = ... ·2 ton.
The weight of the vehicle might be ... ... ·25 „
And that of the motors ... ... ·1 „
·55 ton.

Let us suppose that the weight of the vehicle, the passengers and their luggage, is half a ton, and allow an equal weight for the accumulators and motors. Then the weight of the accumulators will be ·4 ton, and the mechanical work they are capable of effecting would be $16 \times {\cdot}4 = 6{\cdot}4$ H.P. hours.

Now, taking the same data as before, and the formula giving the most favourable result; to drive the loaded vehicle would require, as before:

$$\text{H.P.} = \frac{70 \times 616}{33{,}000} = 1{\cdot}3.$$

The time would be

$$\frac{6{\cdot}4}{1{\cdot}3} = 5 \text{ hours,}$$

and the distance traversed, $5 \times 7 = 35$ miles.

Calling C the weight of the vehicle and passengers, and A the weight of the accumulators and motor, the ratio of useful to total H.P. is:

$$\frac{\text{C}}{\text{C} + \text{A}} = \frac{{\cdot}5}{1} = {\cdot}5;$$

which may be considered a low value.

But we have assumed a perfectly level road; let us now take the case of an incline of 3 in 100. What would then be the H.P. required to propel our traction weight of 1 ton?

Calling radius unity, the incline is ·03 in 1; and $\frac{{\cdot}03}{1} = \tan 1° 42''$. And $\sin 1° 42'' = {\cdot}0297$. The horse-power requisite now becomes:

$$\text{H.P.} = 1{\cdot}3 + \frac{616 \times 2{,}240 \times {\cdot}0297}{3{,}300} = 2{\cdot}54.$$

The time now becomes reduced to 2·5 hours, and the distance traversed to $7 \times 2{\cdot}5 = 17{\cdot}5$ miles (instead of 40).

If the ratio of useful to total H.P., or H.P. hours, is to be maintained not lower than ·5, the question resolves itself into this—Are those who have put forward the assertion that they are able to supply for their cabs accumulators capable of propelling the vehicle 40 miles without recharging, in a position to command a secondary battery capable of doing more than is claimed for the Faure-King battery? If not, they certainly cannot expect to store energy more than sufficient to propel the vehicle 18 or 20 miles on a good road.

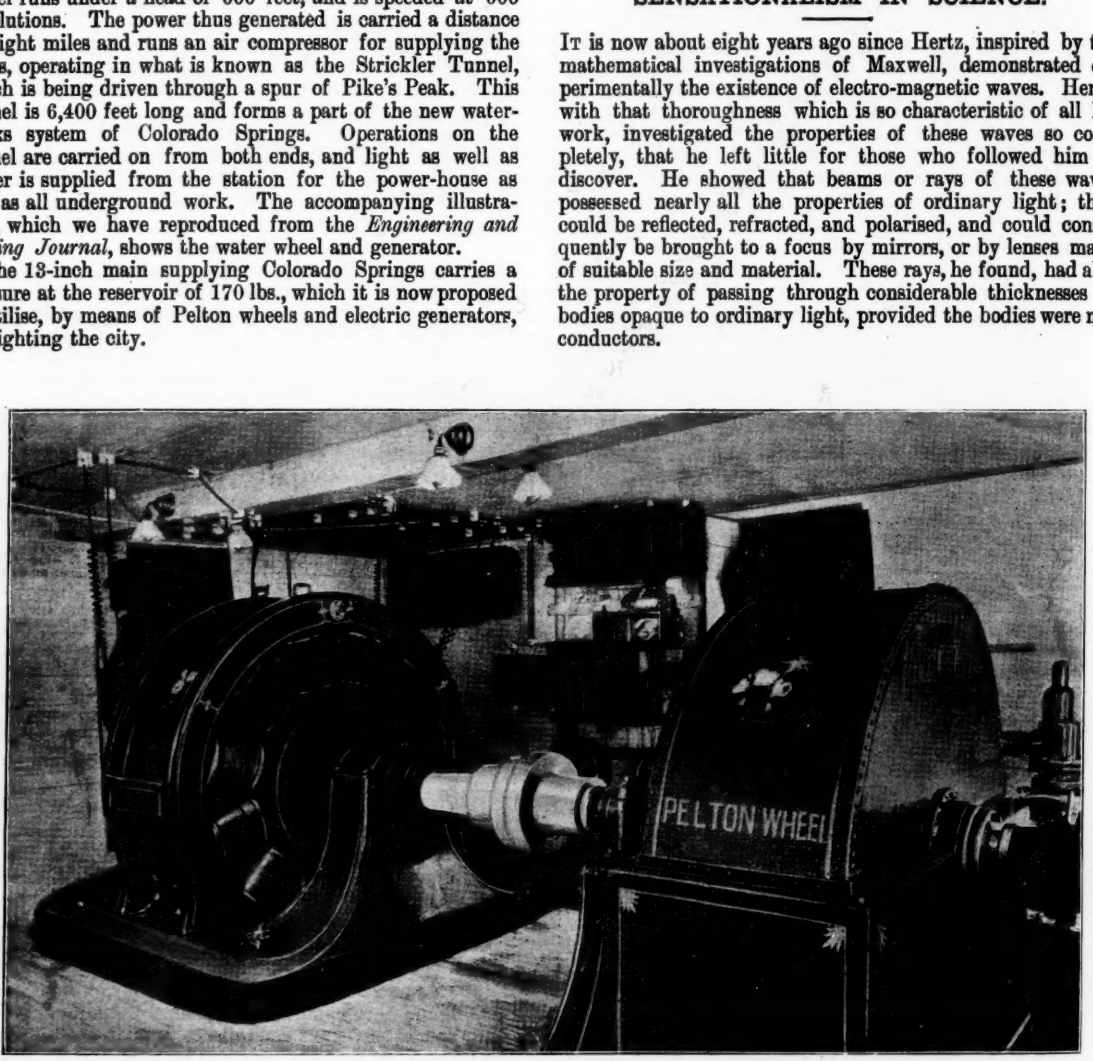
But if the ratio of useful work to total work (which in Reckenzaun's trials was never less than ·7, and in the Paris tramlines worked by accumulators was as high as ·856 some months ago) is allowed to fall lower than ·5, then it may be possible to store energy sufficient to propel the vehicle over 40 miles. But can this be an economical solution of the problem?

Let us take the solitary datum supplied in the prospectus of the London Electrical Cab Company, which has any bearing on this important question. Certainly, 22 B.O.T. units should be amply sufficient to run an ordinary cab for 50 miles on a tolerable road. And 17·6 B.O.T. units, or 13 H.P. hours electrical, should propel a cab for 40 miles. But what will be the weight of the accumulator to store this energy, and what proportion of the latter will be expended unprofitably in merely transporting the accumulator? I have some reason to doubt whether these data will be immediately forthcoming, and whether their importance has, in fact, ever been duly recognised by the promoters of the scheme. But it seems to me that every intelligent member of the public should have satisfied himself on these points before subscribing for a single share in the London Electrical Cab Company, Limited. The public might very reasonably have demanded to see a cab running, say, every day for a fortnight, a distance of 40 miles, by means of the energy stored each day by a single charge of the accumulator. But the least they should have insisted upon is to see the battery that was to do the work—or an aliquot part of it—and to verify the fact of its alleged capability, even under laboratory conditions. For many months past I have been insisting upon the necessity, or, at least, the expediency of allowing the public and their most trustworthy representatives to witness a demonstration of this nature—surely called for by the most ordinary prudential considerations. But it is obvious that the expediency has not been recognised, and that the public has been so unwise as to ignore the necessity. Will anything now be done to show the actual practicability of the schemes which have been put forward?

NEW WATER-POWER PLANT.

A POWER station with some interesting features is located a short distance above the Iron Springs Hotel, at Manitou, Colo., and consists of a 500-H.P. Pelton wheel direct-connected to a General Electric Company's generator. The wheel runs under a head of 600 feet, and is speeded at 600 revolutions. The power thus generated is carried a distance of eight miles and runs an air compressor for supplying the drills, operating in what is known as the Strickler Tunnel, which is being driven through a spur of Pike's Peak. This tunnel is 6,400 feet long and forms a part of the new water-works system of Colorado Springs. Operations on the tunnel are carried on from both ends, and light as well as power is supplied from the station for the power-house as well as all underground work. The accompanying illustration, which we have reproduced from the *Engineering and Mining Journal*, shows the water wheel and generator.

The 13-inch main supplying Colorado Springs carries a pressure at the reservoir of 170 lbs., which it is now proposed to utilise, by means of Pelton wheels and electric generators, for lighting the city.



In this connection we may also mention that the Pelton Water Wheel Company has recently furnished the Alaska Gold Mining Company, at Douglas Island, Alaska, a wheel of such extraordinary dimensions as to make a brief description of interest. The wheel is 22 feet in diameter, and is direct-connected to the shaft of a Reidler duplex air compressor, with air cylinders 24 inches in diameter by 38-inch stroke, having a capacity to deliver 2,800 cubic feet of free air per minute at a pressure of 80 lbs. per square inch. The wheel weighs 25,000 lbs. and serves the purpose of a fly-wheel as well as a prime mover. It runs under a water head of 480 feet at a speed of 75 revolutions, and develops upward of 500 H.P. A hydraulic speed regulator is attached to the wheel, which controls its movement so that a uniform air pressure is maintained on the receiver. The wheel was made of this large diameter to give proper speed to the compressor under the head in this case available.

This is probably the largest tangential wheel ever constructed and shows the facility with which these wheels can be adapted to unusual and extraordinary conditions. In a case like this the transmission machinery to carry such an amount of power would involve a heavy outlay as well as constant expense in maintenance, besides a material loss of power; a direct connection to water wheel of machinery operated without intermediate gearing is, therefore, of great advantage wherever possible.

SENSATIONALISM IN SCIENCE.

IT is now about eight years ago since Hertz, inspired by the mathematical investigations of Maxwell, demonstrated experimentally the existence of electro-magnetic waves. Hertz, with that thoroughness which is so characteristic of all his work, investigated the properties of these waves so completely, that he left little for those who followed him to discover. He showed that beams or rays of these waves possessed nearly all the properties of ordinary light; they could be reflected, refracted, and polarised, and could consequently be brought to a focus by mirrors, or by lenses made of suitable size and material. These rays, he found, had also the property of passing through considerable thicknesses of bodies opaque to ordinary light, provided the bodies were not conductors.

The apparatus used by Hertz for producing these waves consisted of two similar conductors separated by an air spark gap; and the receiver or resonator consisted of a metallic ring with a short air spark gap capable of slight adjustment. Since the publication of Hertz's discoveries, Lodge has invented a much more sensitive receiver—the so-called coherer which is acted upon by the Hertzian waves very much as the microphone is acted upon by sound. It consists of a tube filled with coarse iron filings and put in circuit with a sensitive galvanometer and a voltaic cell. When Hertzian waves strike the filings, their resistance is considerably reduced and the galvanometer shows a deflection. Lodge also has made some interesting experiments with a large lens made of pitch; and has succeeded by this means in projecting the Hertzian waves to a considerable distance. Still more recently Marconi has succeeded in transmitting signals to a distance of over a mile by means of these waves.

The latest work on Hertzian waves has been done by Jagadis Chunder Bose, M.A., D.Sc., Professor of Physical Science, Presidency College, Calcutta, who described his beautiful apparatus and experiments at the recent meeting of the British Association at Liverpool. His paper (ELECTRICAL REVIEW, Vol. 39, p. 400), describes very elegantly

constructed apparatus for exhibiting and measuring the already known properties of Hertzian waves. His radiator is slightly different in detail, though the same in principle as Hertz's oscillator. His receiver is a modified form of Lodge's coherer. A stand with a divided circle enables angles of reflection and refraction to be readily measured; and arrangements are also made for exhibiting polarisation and other effects analogous to those exhibited by light.

These, we believe, are the plain facts of the history of Hertzian waves. Prof. Bose would himself be the last to assert that he has made any very great advance in this field; his claims for himself are not, we think, equal to his deserts; but it cannot, with any regard to the facts, be said that he has done anything more than improve the form of the already known apparatus, and made some valuable measurements and observations.

Now we will take the account of the sensational journalist. In *Pearson's Magazine* (Double Christmas Number) is an article on "An Electric Eye," by M. Griffith. The sub-title prepares us for something startling:—"The marvellous discovery of an Eastern professor which distances the Röntgen rays as they distance photography." A little further on we read, "Even in the domain of modern sciences working under insuperable difficulties, an Indian professor has done remarkable work, and his paper on 'Electric Waves,' read before the British Association, caused quite a sensation among the many distinguished European *savants* present." If the statement had been "among London newspapers and magazines," we should have willingly admitted to it. But let us extract a few more gems from this picturesque and marvellously well-informed article:—"Prof. Bose has been working in the region of lights which are invisible to us, produced by electric waves in the ether, and *he has discovered* that these invisible lights have the power not only of penetrating the atmosphere and ordinarily transparent substances, but also such unpromising materials as doors, brick walls, granite, rock (*sic*), mounds of earth, and, above all, of retaining their active properties after the passage."

The writer of the article is evidently of a practical turn of mind, and sees a great future in the arts and manufactures for this so-called discovery:—"In the future we shall be able to tell infallibly whether our billiard balls are made of ivory or celluloid, however good the imitation, and whether the sideboard is really oak, or a dressed up cheaper wood." The only way we can imagine this testing process to be carried out would be to cut a piece out of the sideboard, in order to test its refractive index by the Hertzian waves; and this drastic course would settle the point in a much simpler way.

Nothing, however, shows the writer's complete ignorance of the very elements of physical science so much as some of the questions put to the Professor. "Then, Professor, light and sound are mere vibrations?" Does M. Griffith imagine that the Eastern Professor has also discovered that light and sound are mere vibrations? Any schoolboy—or, at least, any boy with an elementary Science and Art Department certificate—could have supplied this information. It is not to be wondered at, after this, that the interviewer of Prof. Bose had never heard of the work of Hertz, or of Fitzgerald, or of Lodge. Prof. Bose himself, indeed, supplied the interviewer with these historical facts, but they fell on an ear that would not hear. Prof. Bose says, in the course of his remarks: "The great English scientist, Maxwell, made predictions about them. Hertz was the first to actually verify the existence of these electric waves, though two other eminent British physicists, Profs. Fitzgerald and Lodge, have made many important investigations with them."

We can imagine how unpleasant it must be for a really genuine scientific man like Prof. Bose to have been placed on this bad eminence by the stupidity of this interviewer. That no blame attaches to the Professor for the ridiculous statements in the article is shown by the letter of repudiation he has already sent to a contemporary. In his letter he says: "The interview which the writer of the article in the magazine had with me was printed within inverted commas. But there are other portions which are very inaccurate and misleading. In the proof submitted to me, these latter were cancelled out; but no notice was taken of my corrections, and very sensational things have been added, though I was assured such things would be excluded."

It is a pity this misleading claptrap, this kind of scientific sensationalism, should be disseminated among the tens or hundreds of thousands of readers of *Pearson's Magazine*. The true vocation of the writer of the article is evidently fiction; but it is not legitimate to serve up fiction under the guise of scientific fact. The spreading of such erroneous notions about scientific discoveries is calculated to do a great deal of harm. We do not mean only to nervous old ladies who may look forward with terror to the time when, to quote the interviewer, "we shall soon be nothing but transparent heaps of jelly to each other," and "I can sit by own fire side and spy upon the doing of my friends and enemies in their homes two or three streets away," but there is really now a large section of the general public interested in science, and eager for some knowledge of its latest achievements; they ask for bread, and have received a stone.

BRISTOL CORPORATION AND THE TRACTION QUESTION.

Our correspondent writes that scarcely any question in memory has created more controversy in Bristol than that with regard to the Bristol Tramways Company's big scheme for electrical traction on the overhead trolley system, and the subject occupied the Town Council for nearly four hours on Tuesday. On behalf of the company, each member of the Corporation had been furnished with a huge book setting forth the names of about 17,000 residents of Bristol and the suburbs, who had forwarded postcards expressing themselves anxious to see an extension of electric traction. Councillors who took the company's side urged this to be a strong expression in favour of the scheme, but others argued that the postcards were in such general terms that it was quite consistent for those who signed to support the attitude of the Corporation's Traction Committee. Copies of reports from Mr. Parshall, Dr. Hopkinson, and Lord Kelvin, were also forwarded to the Council by the tramway company, in reply to the report of the Civic Traction Committee; but on behalf of the Traction Committee it was replied that the two last-named gentlemen expressed themselves in very guarded terms, and their opinion needed modification, inasmuch as the Civic Electrical Committee did not propose to supply the direct current needed for the tramways from their present generators, which are of the alternating type. Practically the whole discussion centred around two proposals of the Traction Committee, one that the company must take its power from the civic station, the other that the company may be called on, at the expiration of five years, to put down improved plant if an improved system has been discovered in that time. The Coventry clause, it was suggested by the chairman of the Electrical Committee, would not meet his views on the latter point; and as to the former, he offered to withdraw his claim to supply the current from the city station if it could be shown that the cost to the company would be greater than the electricity would cost the company to produce themselves. Ultimately the position taken up by the Traction Committee on both of the two points named was approved by a majority of votes.

On Wednesday, the managing director of the Bristol Tramway Company, Mr. George White, sent a letter to the town clerk of Bristol informing him that his board had decided to abandon all extensions, inasmuch as the directors could not agree to accept the conditions the Corporation had laid down. The company would be prepared to extend their system when less objectionable conditions were proposed.

CORRESPONDENCE.

The McDonald Battery.

Referring to your leading articles and correspondence regarding the McDonald battery, I might cite the favourable opinions of many leading electricians of much higher standing than any who have appended their names to various hostile criticisms, but I will content myself with asking if it would not be wiser to suspend your final judgment until the practical results of the various trials which the Syndicate are applying are made known. These are, fitting up a yacht—

between 50 and 60 feet in length—with the batteries, and building an auto-carriage and quadra-cycle. We do not mean to ask a penny from the public unless we prove our statements. If we fail, as sensible Scotchmen, we will "pay up and look pleasant," but if we succeed, as we believe we will, probably many of your readers will be glad if they can persuade us to give them an allotment in the new company.

Hugh Rose,
Chairman, McDonald Patent Battery Syndicate.

[We insert this letter for what it is worth. It does not alter the attitude we have taken up one jot, but we would just like to have the names of many leading electricians of any standing at all who will come forward to combat the arguments we have advanced against the battery.—Eds. Elec. Rev.]

"Autocars."

Allow me to correct a slight mistake in your issue of December 4th, in which your reviewer says, referring to Farman's book on "Auto-Cars," published by Whittaker and Co., that "it is a translation from the French of Lucien Serraillier."

Though I have added some information in the form of appendices, I am merely the translator, M. Farman being the author of the French work.

Lucien Serraillier.

Free Lamps.

I do not see how the Bradford Corporation are going to make the "free lamp" system pay, considering they will have to give away £586 or more a year on lamps which would otherwise be profit. According to this, the consumers will have to consume 28,128 units extra a year, which seems to me a large amount, which is equal to one 16-C.P. lamp burning for 468,800 hours, or 468 16-C.P. for 1,000 hours. The total units consumed last year was 673,700. In Bradford "arc lamps" take a big part, and the units consumed on these must be very large. How are they going to tell how many units are consumed for incandescent lighting where they have arc lamps connected through the same meter?

Mr. Gibbing's figures look very nice on paper, but I am afraid he will not get the same result on a practical test, as the "free lamps" are bound to wear, and units will drop accordingly.

Consumers, as a rule, burn their lamps until they become very black or the filament breaks, and if supplied with new ones, will keep them until some break or become extremely black and then replace with new ones, and if old ones will give any light at all, they will replace them in some out of the way corner (this is done at the present time). Thus they will not consume more units than they did before, and be the owner of a few new lamps free of charge. It is not likely they will always be putting new lamps in. I could understand if the Bradford Corporation were to supply lamps taking 4 or 4½ watts per C.P. and making up the difference that way, but how about the poor consumers; their bills are heavy enough now, and this is partly the cause of the higher voltage at Bradford and the bad efficiency of the 8 and 16 C.P. lamps. I should like to know the difference between the bills of the year 1894 and 1895 of some of the consumers? My opinion is they must be higher?

Of course the Corporation had a nice surplus last year, and can afford to make it better for the consumers, but I am afraid at their own loss.

Why not give a bonus in the way of carbons to customers who use arc lamps; as it stands it is a one-sided affair.

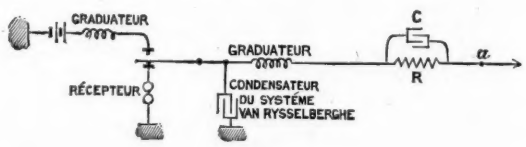
J. G. B.

Telephone Trunk Lines.

Dans un article publié par M. J. Gavey, Member of the Institution of Electrical Engineers, dans le No. 990 du 13 Novembre dernier, de votre intéressante revue, je lis ce qui suit:

"With a high speed transmitter working an ordinary telegraphic circuit to earth, in the usual manner at the far end, and a current of 30 to 40 milliamperes, the balanced telephone circuit may be practically silent. Add a shunted condenser and disturbance may become most marked. . . . . When a shunted condenser is fitted at the extremity, the rise and fall of potential is practically instantaneous, and the effect on the telephone circuit is at its maximum; whereas with the conditions for simple working the electro-magnets of the receiving instrument cause a flattening of the current-curve, and the rise and fall of potential is too slow to injuriously affect the telephone."

Vous connaissez certainement le système de télégraphie et de téléphonie simultanée de Van Rysselberghe, et vous savez que ce système doit ses propriétés spéciales au fait que les courants transmis à travers un on plusieurs électro-aimants, à coefficient de self-induction approprié, n'actionnent pas le téléphone relié en dérivation au circuit on intercalé dans celui-ci. Van Rysselberghe a utilisé la propriété des électro-aimants signalée par M. Gavey et en vertu de laquelle "the current-curve is flattened." Cela étant, l'introduction d'un condensateur shunté dans un circuit armé d'apres le système anti-inducteur Van Rysselberghe doit avoir pour effet de détruire l'action de ce système et la téléphone doit se trouver actionné par les courants du télégraphe. Telle est certainement l'opinion que l'on se forme si l'on s'en tient purement et simplement à la règle bien connue, d'aprés laquelle un circuit possédant de la self-induction et dans lequel on introduit un condensateur shunté est egal à un circuit sans capacité ni self-induction quand les trois facteurs (self-induction L, capacité C, résistance R) sont tels que $L = C R^2$. Dans la pratique, cependant j'ai pu observer que les choses ne se passent pas précisément de cette manière. En effet, depuis prés de trois ans fonctionne à Bruxelles (Central) une installation dans laquelle intervient un con-



densateur shunté. La figure ci-dessous en donne le schéma et j'en parle plus longuement dans mon "Manuel de télégraphie et de téléphonie." Elle dessert un fil employé à la fois pour le télégraphe et pour le téléphone et elle est, comme toutes les autres, pourvue des organes d'anti-induction de Van Rysselberghe. Or, on observe que le condensateur shunté n'ôte rien aux propriétés graduatrices du système en question, car un téléphone relié au circuit, en *a*, demeure silencieux aprés comme avant l'introduction du condensateur shunté.

Je vous avoue, Monsieur le Rédacteur en Chef, que je trouve difficilement à m'expliquer ce phénoméne et je crois qu'il sera intéressant de le signale, d'autant plus qu'il semble démontrer que l'assertion de M. Gavey est inexacte. Je serais heureux si l'un des collaborateurs à votre revue voulait bien me donner la clef du mystére.

Je vous presente, Monsieur le Rédacteur en Chef, avec mes remercîments, l'expression de ma parfaite considération.

J. Pierart.

Bruxelles, *December 1st*, 1896.

Measurement of the Resistance of Street Railway Cables.

I shall feel much obliged if you will insert the following remarks "On the measurement of the insulation resistance of street railway cables": —The method recently described by Chas. Hewitt is by no means so novel as that gentleman appears to assume. I described in 1888 (*Centralblatt für Elektrotechnik, No.* 22) how to utilise the bus bar pressure and a voltmeter for the purpose of measuring the insulation. At that time, to be sure, the Weston voltmeter had not been invented, and I applied the torsion galvanometer of Siemens and Halske. I emphasised the fact, however, that, instead of this, any other good instrument for measuring pressure might be used. I have described the method every year since then, in my *Kalender für Elektrotechniker*.

F. Uppenborn.

Munich, *December 4th*, 1896.

A Patent Museum.

Some of your readers are aware that a committee has been formed to promote a National Museum, in which examples of railway practice may be preserved, in addition to the few now shown in the Exhibition Galleries at South Kensington. At the same place there are a number of models of great interest to engineers — civil, mechanical, hydraulic, and electrical—as well as to inventors generally, and many of these were transferred to the Science and Art Department from the old Patent Museum, by the Patents, Designs, and Trade Marks Act, of 1883.

While the Patent Museum was at the so-called "Brompton Boilers," the exhibits were not only open free each day to the public, but also until 10 o'clock at night for three nights in the week, and it was a most valuable and interesting collection. But since its transfer to the western side of Exhibition Road, a less convenient spot for most of its former visitors, it has not been opened at night until April last, and, consequently, much of its former usefulness has been impaired.

My object in writing, is to ask your assistance in re-establishing the Patent Museum, but this time at the Patent Office itself; so that it may be in a more central and accessible spot, and as supplemental, as it were, to the most valuable and most accessible technical library in the country. If the models and exhibits referred to were removed to Southampton Buildings, their place at South Kensington could readily be filled with the railway relics aforesaid, so that the two projects are of mutual assistance. But in addition to the old collection, new models and new materials, illustrative of modern progress, should be provided from time to time, and these, as far as possible, should be substantial enough to be freely handled. The usefulness of such a museum, at such a place, is obvious.

It is not generally known that the cost of building large extensions to the Patent Office, now in progress, is provided for out of the annual surplus of the Patent Office. In 1895 that surplus was £96,500, out of which £10,160 was expended in connection with these extensions, and the Government are about to obtain power to acquire more property. Is not this a fitting time, Sir, to urge upon the Board of Trade the re-establishment of a Patent Museum, and have not inventors a prior claim upon, say, £5,000 a year of this surplus to meet its cost? It might be, and should be, made the finest technical museum in the country; and in these days of foreign competition we cannot afford to lose any opportunity of teaching and guiding our inventors and others interested along scientific paths, and inciting them by the ingenuity of their predecessors.

J. Sinclair Fairfax.

[This is a matter which is well worthy of consideration now that so much interest is centred in technical education. The proposal which, we believe, has already been made elsewhere, should be followed up.—Eds. Elec. Rev.]

Induction in Multiple Core Cables.

Mr. Dresing in his letter of December 1st forgets that the whole principle of shielding conductors in multiple cables, submarine or aerial, from the effects of electrostatic induction was developed by me in 1878 (*V. Phil. Mag.*, April, 1878), and that tin foil was used for that purpose in that year in the streets of London. The plan was not patented, and as a consequence, I have rarely been credited with the invention.

W. H. Preece.

December 8th, 1896.

ELECTRIC TRAMWAYS FOR BRADFORD.

Mr. Alfred H. Gibbings, the borough electrical engineer at Bradford, has presented an interesting report to the chairman and members of the Gas and Electricity Supply Sub-Committee on the proposed electric tramways for those districts of Bradford known as Great Horton and Bolton. After referring to the advantages that would arise out of the arrangement of the Corporation Lighting Works supplying the necessary energy for working the tramways along certain routes, Mr. Gibbings gives the following figures:—

Great Horton Route.

Fifteen Minutes' Service.

Length, 2 miles 1,500 yards.
Number of cars required, 4.
Car miles per annum, 100,000.
Average speed, 6 miles per hour.
Outward journey occupies 30 minutes

Capital cost:—

Rails, cables, paving, &c.	£15,060	
*Four cars at £400 each	1,600	
Sheds and offices	2,000	
	£18,660	

* Add £400 for each additional car required for emergency traffic.

Estimated Cost of Running per Car Mile in Pence.

Working costs.	Electricity at 1½ unit per car mile ...	2·00d.	
	Wages of drivers and conductors ...	2·62d.	
	Repairs to stock and plant	0·48d.	
	Lighting and cleaning	0·19d.	
	Repairs to electric feeders	0·02d.	
	Compensation for damage	0·20d.	
	Management	0·59d.	
	Stationery	0 06d.	
	Total working costs... ...		6·16d.
Standing charges.	Depreciation, cars	0·38d.	
	„ remainder	1·02d.	
	Interest, 3 per cent.	1·33d.	
	Sinking fund, 3 per cent.	1·33d.	
	Rates and taxes	0 52d.	
	Total standing charges ...		4·58d.
	Grand total		10·74d.

Ten Minutes' Service.

Number of cars required, 6.
Car miles per annum, 150,000.

Capital cost:—

Rails, &c.	£15,060
*Six cars at £400 each...	2,400
Sheds and offices ...	2,540
	£20,000

* Add £400 for each additional car required for emergency traffic.

Total working costs per car mile ...	...	5·64d.
Total standing charges do. ...	...	3·92d.
Grand total	...	9·56d.

Bolton Road Route.

The foregoing figures are also representative of the cost of running on the Bolton Road route, but owing to the length being shorter, the cost per car mile will be about 25 per cent. greater than on the Great Horton line.

Combined Routes.

I have taken these two lines, and estimated the cost of running each as an independent concern. If, however, these lines were worked conjointly, it is clear that many of the items which make up the cost per car mile would be very considerably reduced, such as charges for management, depreciation, repairs, interest and sinking fund, rates and taxes, &c., probably bringing down the cost to 9d. per car mile.

It will also be seen that the additional capital required for a 10-minute service, as compared with a 15-minute service, is small compared with the very material reduction gained in the costs per car mile, and if the traffic will at all allow, I would recommend a 10-minute service to begin with.

As the traffic increased so the service period could be diminished; and with reference to the probable traffic as compared with present pedestrian traffic, I think a good analogy exists in the results of canvassing for electric light customers compared with the results in applications when once the cable is laid, of which the Committee have recently had several experiences.

The Effect of the Combined Undertaking on the Electricity Works.

The power required for tramcar driving being used in the day time, and the batteries taking up the load at the time of maximum demand upon the electric lighting plant, it follows that the cost of supplying the power will be confined to the cost of generation and the usual allowance for repairs and maintenance. Any charge above this will, of course, be entire profit to the department.

In 1895 the Bradford Electricity Works costs for generation, repairs, and maintenance, were:—

Coals	·56d.	per unit.
Oil, &c.	·16d.	„
Repairs	·21d.	„
Total	·93d.	per unit.

or, say, 1d. per unit, to include wages of one additional man.

If, therefore, a charge were made of 1½d. per unit to the tramway department, we should receive ½d. per unit profit, and this would represent, for an estimated sale of 133,000 units in the year, an income of £277 1s. 8d. Of course this is a small income, but it is gained without any additional expenditure whatever in the electric lighting department, and, moreover, it is representative only of (1) a 15-minutes' service; (2) one length of route; and (3) a definite mileage per annum.

If the service, for instance, were altered to 10 minutes, the income would be increased 50 per cent, and so on for increases of mileage and lengths and number of routes.

The ultimate effect of such a combined undertaking would, of course, be the possibility of a very great reduction of the price per unit charged for lighting purposes. To the electric lighting concern the aquisition of a substantial day-load is of the utmost possible consequence, but further than this there is no need to complicate the arrangement between the two departments. It will be sufficient if we assume that:—

1. The Electricity Committee retain their independent position, and make a definite charge per unit for all current supplied.
2. That this output is merely considered as a day load.

One further condition, however, is absolutely necessary, viz, that the tramway department, having once made the arrangement for a supply of electricity, it should be considered to be a permanent relationship between the two Committees.

BUSINESS NOTICES, &c.

Electrical Wares Exported.

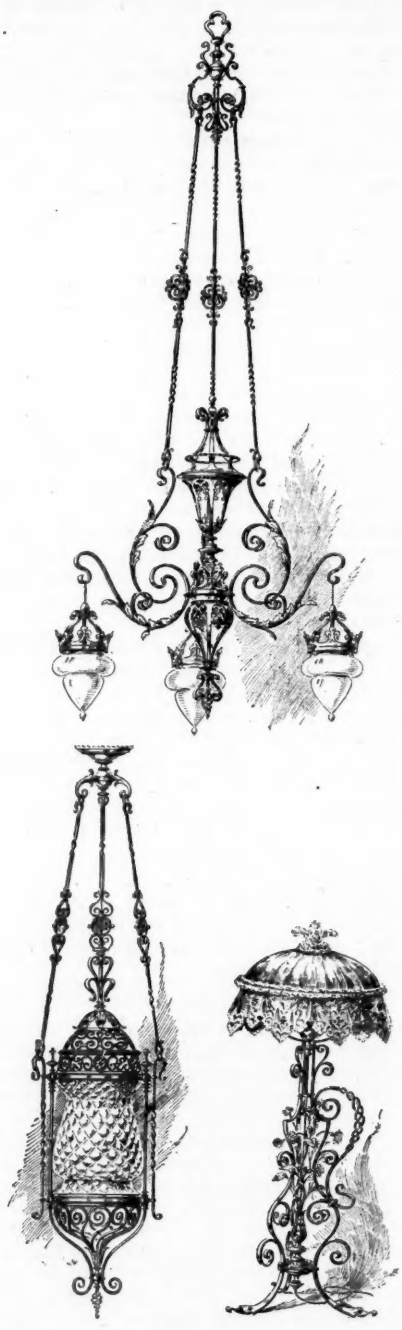
Week Ending Dec. 8th, 1895.	£	s.
Algoa Bay	10	0
Alexandria	64	0
Amsterdam	50	0
Auckland	48	0
Barbadoes	16	0
Bombay	128	0
Brisbane. Telep. mtl. ...	70	0
Brussels	186	0
Buenos Ayres	60	0
„ Teleg. mtl.	209	0
Cadiz	8	0
Calcutta	250	0
Campara	380	0
Cape Town	83	0
Demerara	16	0
East London	579	0
Flushing	15	0
Fremantle	64	0
Genoa. Elec. dynamos...	1,524	0
Gothenburg. Teleg. cable	380	0
Hamburg. Teleg. mtl. ...	250	0
Hong-Kong. 10 tons old telegraph wire ...		
Larache	23	0
Mauritius. Teleg. mtl...	29	0
Monte Video	35	0
Negasaki. Teleg. cable	52,000	0
Odessa	84	0
Otago	12	0
Penang	96	0
Perth	10	0
Revas	116	0
Rotterdam	15	0
St. Petersburg. Teleg. mtl.	265	0
Shanghai	88	0
Singapore	30	0
Stockholm. Teleg. mtl.	180	0
Sydney	81	0
Townsville	250	0
Trinidad	18	0
Wellington	15	0
Total	£57,732	0

Week Ending Dec. 8th, 1896.	£	s.
Adelaide	61	0
Albany	705	0
Alexandria. Telep. mtl.	159	0
Amsterdam	120	0
„ Teleg. mtl. ...	492	0
Barcelona	100	0
Bombay	14	0
Boulogne	6	0
Brisbane. Telephones ...	60	0
Brussels	22	0
Buenos Ayres.	157	0
Calcutta	463	0
„ Teleg. mtl. ...	78	0
Cape Town	1,013	0
„ Teleg. mtl....	3,482	0
Colombo	55	0
Copenhagen. Teleg. wire	25	0
„ Teleg. mtl.	42	0
Delagoa Bay	69	0
Durban	946	0
East London	644	0
„ Teleg. mtl....	3,864	0
Gothenburg. Teleg. wire	214	0
„ Electric mtl.	180	0
Kilidini. Teleg. mtl. ...	350	0
Le Treport	11	0
Lyttleton	140	0
Madras	7	0
Madeira. Teleg. mtl. ...	120	0
Melbourne	106	0
„ Teleg. mtl. ...	17	0
Nagasaki. Teleg. mtl. ...	1,580	0
North Atlantic. Teleg. cable	2,040	0
Port Elizabeth	74	0
„ Teleg. mtl.	1,056	0
Rio Janeiro	17	0
Rotterdam. Teleg. mtl.	14	0
Shanghai. Telep. mtl.	27	0
Singapore	16	0
„ Telep. mtl. ...	65	0
Sydney	418	0
„ Telep. mtl. ...	345	0
Trinidad	11	0
Wellington	325	0
Yokohama	17	0
Total	£19,727	0

Allgemeine Elektricitäts Gesellschaft.—In reference to our notice of the annual report of the Allgemeine Elektricitäts Gesellschaft, Berlin, in our "City Notes" last week, the Electrical Company, Limited, asks us to correct the misapprehension that Dr. G. Siemens is a physicist; he is director of the Deutsche Bank, Berlin. The Director-General of the Allgemeine Electricitäts Gesellschaft is Mr. Emil Rathenau.

Alwyn v. Harper.—At the City of London Court last Friday, the plaintiff claimed the sum of £5 5s. for electrical engineering work done. The plaintiff's case was that an order was given to him by the defendant for certain electric light fittings. While the work was proceeding the defendant wished for some alterations to be made, and those alterations he (the plaintiff) refused to accede to, unless the defendant paid the extra cost. Judgment was entered for plaintiff for the amount claimed, and also for the plaintiff on a counterclaim.

Benham & Froud's New Show Room.—By a thorough rearrangement of premises, Messrs. Benham & Froud recently managed to add to their already extensive range of show rooms, one specially and solely devoted to electric light fittings. The entrance is at the back of the room in which is always an interesting display of the ecclesiastical brasswork for which this firm had earned a reputation in the early years of the century, as they were chosen to produce in 1821 the ball and cross now surmounting St. Paul's. Messrs. Benham & Froud have always adopted the policy of supporting and protecting the trade, and do not themselves undertake installations, or any other electrical work. We give illustrations of three new fittings now on view, which have been much admired.



Catalogue.—Messrs. Mavor & Coulson, of Glasgow, have issued an "Electric Light and Power" catalogue, dated November, 1896. Useful information as to how to ask for an estimate is given, followed by a number of excellent full page illustrations of combined plants, double and single magnet dynamos, and motors. There are views of steel-cased and geared motors, also drawings of the "Blyth" windmill, the "C.C." system of concentric wiring, fittings, pendants, brackets, and sundries. The pages are divided off into sections by means of a thumb index. The dynamo and motor section contains a good deal of descriptive matter, tabulated and otherwise. The concentric wiring division deals very exhaustively with the "C.C." system. Nicely bound in light brown thick cloth covers printed in black, the catalogue is a very creditable production, as well as being very useful.

Changes of Address.—Mr. S. Bousfield Tatham, electrical engineer, informs us that increased business has necessitated his removal to larger offices and show rooms at 26, Thurloe Place, South Kensington, W.

Messrs. Julius Sax & Co., Limited, announce that, owing to increasing business, they have removed their wholesale department to more extensive premises, known as Forester's Hall, Clerkenwell, E.C.

Messrs. H. Binko & Co., inform us that, owing to increased business, they have had to acquire additional premises at 120, Minories, E., where all machinery used will be exclusively worked by electric motors.

Corporation Show Room.—On 2nd inst. the Bradford Corporation opened an electricity show room at Swan Arcade. The appliances now exhibited show the application of electricity for lighting, heating, and motive power purposes. A special effort is made to popularise electric motors. The following manufacturers have motors on show:—Crompton & Co., Limited; J. H. Holmes and Co.; "Standard" Dynamo and Motor Manufacturing Company; Rosling & Appleby; and the Phœnix Dynamo Manufacturing Company. The Corporation is making no charge for admission to the show rooms. This move will doubtless bring many additional customers.

Conversion Tables.—Messrs. Verity's, Limited, are distributing throughout the trade a conversion table card, which is one of extreme convenience for the many people in the electrical business who frequently have to make tedious calculations as to the cost of cable. This table is purely a ready reckoner, and can be used in conjunction with any price list. It was designed by Mr. M. B. Cotterell for ascertaining the prices of wire and cable per yard, coil, or mile. The centre circle has the price per mile, and from the outer circles may be ascertained the other prices.

Dissolution of Partnership.—Messrs. W. T. Golledge and J. R. Macdonald (Macdonald and Golledge, electrical and mechanical engineers), formerly carrying on business at 39, Eastgate Street, and afterwards at St. Aldate Street, Gloucester, have dissolved partnership by mutual consent. J. R. Macdonald will continue the business alone and will attend to debts.

Electrical Engineering in Italy.—Application has been made for a concession to put down plant to utilise the water-power of the River Brembo in the generation of electrical energy for lighting and power purposes, in the Vaprio d'Adda district.

Electric Welding.—At the *conversazione* given by the Institution of Marine Engineers at Stratford on December 4th, the Electric Welding Company, Limited, of 21, Hendon Street, Pimlico, S.W., showed a most interesting and varied assortment of samples of welding work executed by the Thomson patent electric welding apparatus. In addition to a new type of automatic welder for iron, copper, &c., they exhibited an entirely novel departure, in a complete set of electrically welded fittings for cycle work, which comprised head lugs, main bracket lugs, rear forks and pedals.

Explosion.—A few minutes after 10 o'clock the other night an explosion occurred in a telegraph wire connection box on the pavement in the Strand, immediately opposite Charing Cross Railway Station.

Gas.—On 3rd inst., at 130, Albany Road, Walworth, there was a gas explosion which greatly damaged the premises and injured two of the occupants.

A gas explosion at St. Katharine's Church, Northampton, on 3rd inst., caused damage and fire to the buildings and injury to the sexton.

A gas explosion occurred at a Cromer Bank on Monday. Damage to life and property.

Liquidations.—Under a winding-up order made recently, on a creditor's petition, against Inrig & Chester, Limited, meetings of the creditors and shareholders were held last Tuesday at the Carey Street offices of the Board of Trade. Mr. Cully, Assistant Receiver, reported that the history of the company was very short, and so far as the creditors were concerned, was very disastrous. It was registered so recently as February last, to acquire the business of an electrical and general engineer, carried on at 44—46 White Post Lane, Victoria Park, under the style of the Globe Electrical Company. Mr. A. G. Inrig, who had carried on the business, was looking out for a partner, and met with Mr. Chester, who agreed to join him if the liabilites were limited. The business was consequently converted into a limited company, and Mr. Chester took a certain number of shares, for which he paid by instalments. As time went on, further money was required, and was obtained on loans, secured by a charge over the whole of the assets. At the date of the winding-up order there were three claims to the property, and as they would probably come before the unsecured creditors, there would be nothing for the latter class. An application had been made to the Court to decide who was entitled to the property, and pending the hearing of that application, the Official Receiver would have a valuation made by a competent valuer, with a view to a sale. Mr. Chester was stated to have left the country, so there would be some difficulty in enforcing any liability that gentleman might be under. No statement of affairs had yet been filed, but the unsecured debts were estimated at £1,583, and the assets at £100. The capital of the company was fixed at £2,000, but the only shares that were apparently issued were £500 to the vendor, and £600 to Mr. Chester, or his relatives. The creditors decided to leave the matter in the hands of the Official Receiver, to be wound up in the usual manner.

Mr. E. Wilding, the liquidator in Poole & White, Limited, has published a summary of accounts from March 15th to September 14th, 1896, showing receipts £48 1s. 6d., payments £11 4s. 2d., leaving a balance of £36 17s. 4d.

Lists.—From the Electrical Company, Limited, we have received a pamphlet devoted to their new E. C. incandescent lamp factory, and describing the various processes that the lamps go through in the several departments. There are a number of interesting and neatly printed illustrations showing the employés at work, also a few illustrations of lamps supplied by the company. The list is well got up. The same company have sent us an illustrated price list of apparatus for Röntgen radiography. Instructions and general comments are included.

The Edison-Bell Phonograph Company.—In the Chancery Division of the High Court, on Friday last, before Mr. Justice Chitty, Mr. Moulton, Q.C., moved, in the case of the Edison-Bell Phonograph Company, Limited, *v.* Bernstein, for an injunction restraining the defendant from infringing two letters patent for improvements in the phonograph. Learned counsel said that the validity of both of these patents had been established by law, and he had certificates to that effect. One patent was established after a trial lasting some days, and in regard to the second, there was no contest at the trial, the person against whom the action was brought abandoning his defence. Mr. Willis Bund, who appeared to oppose the motion, urged that the validity of the second patent had never been established; but his Lordship held that the certificate was *primâ facie* evidence of validity, and he accordingly granted an interim injunction until judgment or further order.

Wigston Electrical and Engineering Company.—The *London Gazette* last Friday contains notice that, in response to a petition by Wm. Taylor and W. S. Hubbard (Taylor and Hubbard), engineers of Leicester, Mr. Justice Vaughan Williams made an order that the voluntary winding-up of the Wigston Electrical and Engineering Company be continued, subject to the supervision of the Court. Mr. Arthur Bond Wykes, the voluntary winding-up liquidator, will, on the 28th of each month, file with the Registrar of Companies winding up, a report of the progress being made. Messrs. Crowders and Vizard, of 55, Lincoln's Inn Fields, London, W.C., were solicitors for the petitioners.

ELECTRIC LIGHTING NOTES.

Aberdeen.—The annual statistics in regard to the Corporation electric lighting station will be made up in January, and it is expected that they will be of a very satisfactory character. We hear that Mr. Blackman, the engineer, has succeeded in effecting a considerable saving in the matter of fuel by the use of the cinders from the gasworks, instead of coke for the boilers in the station. The extensions at the station are making progress, the buildings being almost ready for the erection of the machinery. The capacity of the station is now being taxed to the full.

Aberdare.—A South Wales paper says that a project is on the tapis to light Aberdare with electricity, the motive power being supplied from a dynamo at the Gadlys Colliery.

Ambleside.—The District Council last week resolved to make application to the Board of Trade for a provisional electric lighting order.

Bedford.—The Electrical Engineer has reported the presence of coal gas in the electrical street boxes. The Gas Company have previously been communicated with, but it has not been remedied. A correspondent says "proceedings are to be taken against the Gas Company if the matter is not promptly seen to."

Belfast.—A workman in the employ of the contractors met with a slight accident last week, through unintentionally making a short circuit at the switchboard. The electrical engineer has been instructed to proceed without delay with the preparation of the draft plans for the proposed new station, for submission to the Committee previous to application being made to the Local Government Board.

The date for sending in applications for the post of temporary draughtsman to the Belfast Electric Light Department has been extended to December 17th.

The Corporation has given permission to Mr. M'C. Olsson, assistant electrical engineer at the central station, to conduct a class in electric lighting at the Technical School, Hastings Street, on three evenings in the week.

Blackpool.—The Adelaide Street Wesleyan Church is now electrically lighted. Messrs. Drake & Gorham carried out the work.

Boston.—The Town Council has considered the report of Mr. Adrian Collins, A.M.I.C.E., on an electric light installation for Boston Dock. He estimated the cost to include eight arc lamps and wire and fittings for 108 lights, at £1,294 4s., and the probable annual working cost at £152 10s. The scheme was adopted, and the work will be proceeded with. The question of providing an electric light installation for the town was postponed.

Brisbane.—The Brisbane Electric Light and Power Bill was before the Legislative Council on October 21st, and after various clauses had been discussed and amended, the Bill was reported, and set down for third reading on October 27th.

Canterbury.—The Town Council had the electric lighting question before them again the other day, and the matter was discussed with closed doors. The *Kent Herald*, from its own observations, believes that a vast majority of the citizens do not want £20,000 or £30,000 spent "just to provide a few people with the electric light for advertising purposes."

Ceylon.—The Searchers' Office, the Queen's Warehouse, Warehouse A, and the Sundries Warehouse, at the Customs Buildings, are now lighted electrically. Altogether 1,780 C.P. will be expended on the four buildings. The lamps are of 200, 100, 50, and 8 candle-powers. The other Customs, warehouses and buildings, are also being fitted up.

Chester.—The electric light will shortly be introduced at the Royalty, Chester.

Colwyn Bay.—The District Council of Colwyn and Colwyn Bay invites plans, estimates, &c., for an electric lighting scheme for the district, with or without refuse destructors; £30 will be given for the best scheme, £20 for the next best. Particulars from the Surveyor, Mr. Wm. Jones, A.M.I.C.E., Municipal Buildings, Colwyn Bay. January 13th is the latest date for sending in schemes.

Denton.—The District Council on 7th inst. passed a resolution applying for a provisional electric lighting order.

Dingwall and Strathpeffer.—At a special meeting of the Dingwall Town Council last Friday, Mr. Yorke, electrical engineer, Glasgow, and Mr. E. J. Gunn, solicitor, Dingwall, laid before the members a proposal, on behalf of the promoters, for the lighting of Dingwall with electricity by a company which is to be formed. Mr. Yorke pointed out that a joint scheme for both places would materially lessen the initial and working expenses, and what the promoters of the proposed company would like to know was whether the Council would be prepared to enter into a contract with the company for the lighting of the streets. Electric light could be supplied for the streets at the same price as the Corporation now pay for the gas, the light being four times as great; and for private consumption it could be supplied at a charge equivalent to 4s. per 1,000 feet of gas, while the present price of gas in the town was 8s. 6d. per 1,000 feet. The Council were unanimously of opinion that an effort should be made to introduce the electric light, but it was resolved that the proposals of the company should be submitted in writing before a definite decision could be come to with regard to the proposed contract.

Dublin.—The Electric Lighting Committee reports that the Insurance Company had raised their rates from 2s. 6d. per cent. to 10s. 6d. on mains, and 12s. 6d. on buildings. It was also reported that though the capacity has increased, the working expenses have not done so.

Dundee.—For the seven months ending November 30th, £1,423 19s. 1d. was collected for electricity—an increase of £96 16s. 6d. on the previous year. The expense of the electric current for the four arc lamps in High Street was £17 18s. 9d. The Council have entered into contracts for the supply of electricity meters, cast-iron pipes, and cables for electrical purposes.

Messrs. J. & C. Hay have introduced the electric light at their stone-cutting sheds at the new post office works. At the north side two arc lamps have been erected, and these illuminate the sheds. On the south side eight incandescent lamps are introduced under the roof of the shed. Messrs. J. Maxwell & Sons put down the plant.

Gloucester.—The extensive new works of Messrs. Allan Jones & Co. have been fitted throughout with electric light. The power is derived from the large horizontal mill engine and dynamo belt taken off the main shafting of the works. The dynamo is capable of supplying 150 lamps of 16 C.P. There is also a battery of 54 accumulators. The mains and wiring are for 100 16-C.P. lamps. The plant was executed by Mr. A. G. Saunders, of Cheltenham.

Guildford.—The Guildford Electric Light Company has notified the Town Council that it is now prepared to supply current for street lighting, and offering to supply estimates.

Hampstead.—Mr. G. H. Cottam, chief electrical engineer, has, says a contemporary, made a request for further plant at the central station, to meet the demand. As a result, £4,500 is to be spent. The Vestry has 500 private consumers, with 36,000 lamps. The new plant required includes one 300-kilowatt alternator, with switch panel, connections, and foundations; one exciter, with switch panel, connections and foundations; a second feed-water heater; and one overhead traveller for the second bay in the new engine room. The two new boilers at the electric station are to be insured against explosion for the sum of £4,000 each, in the Boiler Insurance and Steam Power Company, Limited, at a total annual premium of £9 (4s. 6d. per £100.)

Hull.—No one anticipated that after the scheme of Mr. Barnard, the electrical engineer, had been reported upon favourably by Mr. Hammond at the Council's request, that the Council would a second time reject it when again recommended by the Electric Light Committee. Such, however, is the case, for the reports of Mr. Hammond and of the Electric Light Committee came before the Council on 3rd inst., and it was then decided, by 26 votes to 24, after very lengthy discussion, to refer the scheme back for further consideration. The Committee met on 5th inst., to consider their position; one member had already handed in his resignation from the Committee, and it was suggested that the whole Committee resign. This, however, was not approved of by Mr. Skinner (the chairman), and others. The matter was gone into again, with the result that the Committee came to the conclusion that the scheme proposed "was the best from every point of view." It was stated that applications were coming in very quickly, and they now had inquiries from the North Eastern Railway Company for 1,900 16-C.P. lamps for the Station Hotel. The new plant was necessary immediately.

India.—The tender submitted by Mr. D. D. Coath for a trial lighting of the main streets of Rangoon by electricity has been accepted at Rs. 3,400.

Kirkby-in-Ashfield.—A brief discussion took place at the last District Council meeting *re* electric lighting. It was stated by the chairman that from information he had received such a scheme would cost £12,000. Ultimately the Clerk was instructed to ask Mr. Furse, of Nottingham, for a rough estimate.

Killarney.—The Town Commissioners on Monday decided to invite tenders for the public lighting of the town for 12 months, by either gas or electricity.

Mile End.—The Vestry has done something to redeem its character by appointing a special Electric Lighting Committee.

Lambeth.—The *London Gazette* for December 4th contains notice given by the Vestry to the effect that that body proposes, with the consent of the Board of Trade, to transfer to the "South London Electric Supply Corporation" the provisional electric lighting order. The Vestry reserves right to purchase the undertaking at stated periods on specified terms. The corporation will pay the Vestry £1,000 to cover its expenses connected with the order. The corporation pays a deposit of £5,000 with the Vestry as a guarantee to complete the compulsory work within two years, the Vestry paying 2 per cent. interest; but the deposit to be forfeited to the Vestry if the works are not completed within three years. The corporation will supply current free of charge to 25 electric arc lamps.

Liverpool.—The Lighting Committee of the City Council have now under consideration a scheme for lighting Bold Street, Church Street, Lord Street, Castle Street, Dale Street, Manchester Street, and St. John's Lane, with electricity, by means of arc lamps. The demand for the electric light on the part of private consumers has increased, and is still increasing so rapidly as to tax the present resources of the electric lighting department to the utmost. As a result, the new generating station in Paradise Street is being pushed forward to completion.

London.—We understand that the Marylebone Vestry is to be asked to co-operate with the Paddington Vestry in the lighting of a part of Edgware Road by arc lamps.

Mevagissey.—The Parish Council, last week, signed an agreement concerning the town lighting with the Electric Light Company. A bill presented from the Electric Light Company for £13, the amount of one quarter's lighting, was ordered to be paid.

Newcastle.—The lapse of several years has been necessary in order to convince the Corporation of Newcastle, in so far as they are represented by the City Lighting Committee, that there is some advantage to be obtained by the introduction or control of a municipal supply of the electric light. Two companies have for the past few years been carrying on business at Newcastle as suppliers of the electric light, and that, too, with a considerable amount of success. But the City Fathers have, says *Daily Tenders and Contracts*, at last awakened to the fact that this branch of industry should be in the hands of the Corporation, and for the purpose of investigating the question of municipal electric lighting, the City Lighting Committee have just paid a visit to Edinburgh. The idea, of course, is for the Corporation to buy out the present companies, although it remains to be seen how this can be done. If we remember rightly, there is no special clause in the provisional orders under which the companies work that would allow of the Corporation acquiring the undertaking before the expiration of the 42 years stipulated by the Electric Lighting Act, 1882. It would thus appear that, failing the existence of a clause of this nature, the Corporation will be compelled to buy out the companies on their own terms, as was the case in Liverpool a short time ago.

The Special Committee, already decided upon, to consider the desirability of the Corporation undertaking the provision of electricity, has now been appointed by the City Council.

Oldham.—The Oldham Equitable Co-operative Society, Limited, requires a consulting engineer to prepare plans, &c., for, and to supervise the erection of, an electric lighting and power plant for its new central premises. For further details see our "Official Notices."

Quarry Lighting.—Mr. John Fyfe has had his Kemnay quarries lighted by electricity. The current is conveyed by overhead wires from a dynamo situated at the engine works a quarter of a mile distant. At the quarries poles were erected round the rim of the openings into the earth, and wires strung across the mouth of the quarries. The lamps are of 3,000 C.P. each. The installation was effected by Messrs. P. C. Middleton & Co., Aberdeen.

Railway Station Lighting.—We learn that the North-Eastern Railway Company is about to introduce the electric light at the Kerkby Stephen station, water-power from the River Eden being made use of for the purpose.

Ramsbottom.—The District Council has resolved to apply to the Local Government Board for electric lighting powers.

Reading.—The Corporation is to make arrangements with the Reading Electric Supply Company for the lighting of the whole of the public buildings (new Art Gallery, &c.), by electricity, if the company agree to supply current at 4½d. per unit.

Reigate.—Messrs. Edmundsons & Co., Limited, have been corresponding with the Clerk in regard to a proposal to light the borough electrically. Letters referred to Committee.

Romsey.—The Berthon Boat Works have been lighted by electricity, a dynamo supplied by Messrs. Parker furnishing current for the 80 incandescent lamps. Mr. H. N. Warburton, of Blockley, Worcestershire, superintended the work.

Rotherhithe.—The County of London and Brush Company asked the Vestry to reconsider its decision to oppose their application for a provisional order. They offered to supply current for street lighting purposes at 3½d. per unit. The Vestry, however, adheres to its decision.

Shoreditch.—The draft of the proposed agreement with the Electric Lighting Extension Syndicate, Limited, was before the Vestry last week. It was referred to the Electric Lighting Committee.

Sunderland.—Some new and very extensive business premises of Messrs. J. T. Calvert & Co., Limited, are to be lighted by electricity. Jandus arc lamps will be used on the ground floor, and incandescents below and above. Mr. Davison Taylor has executed the work.

Watford.—The District Council, on the 31st inst., holds a special meeting to consider a resolution applying for a provisional order for electric lighting.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Bedford.—An application has been made to the Town Council by Mr. J. G. W. Aldridge, who wants to run electric cars in the streets. The matter has been referred to the Electric Light Committee.

Belfast.—The Belfast Street Tramways Company have, according to *Daily Tenders*, rejected the terms proposed by the Corporation as a condition precedent to laying down the proposed electric plant for the working of the tramways. The next move that will be taken in the matter is uncertain.

Cardiff-Penarth.—The Penarth Tramway Syndicate, Limited, of 124, Bute Street, Cardiff, is issuing a pamphlet to the public explaining the subject of "electric tramways as a means of rapid transit in and near town." An illustration, showing the Bristol tramways on the electric trolley system, is given as a frontispiece.

A representative of the *Western Mail* has interviewed Mr. L. B. Atkinson, who has taken a prominent part in the promotion of this scheme. That gentleman stated that the Syndicate is composed of about 25 gentlemen, everyone of whom is either a resident or occupies a prominent position in the commercial life of Cardiff or Penarth. He stated further that the overhead trolley system is to be employed. Whether the supply will be taken from the Cardiff Corporation supply station or from a power station to be put down by the company is uncertain at present.

Coseley.—At the last District Council meeting, alluding to the tramway amalgamation scheme, Mr. Rollinson thought they should be careful to safeguard the interests of the parish. He gave notice that at the next meeting he should move a resolution that the council apply for a provisional order for electric lighting and motive power. It was decided to request the Sedgeley District Council to meet them to consider the tramway question.

Dover.—At last week's Council meeting, a detailed report, to which we referred last week, was submitted by the town clerk and surveyor, and after the matter had been discussed at some length, it was decided to adopt the tram system and refer the details of the question to a small committee for consideration. The town clerk has been requested to communicate with the Dover Electricity Supply Company in order to ascertain upon what terms they would be prepared to supply motive power.

Dundalk.—At last week's meeting of the Dundalk Town Board, Mr. James Gaskin, C.E., borough surveyor, reported that plans, &c, of an electric tramway for Dundalk and Blackrock had been lodged with him in compliance with the Act of Parliament. The Tourist Development Syndicate are seeking for a provisional order to enable them to carry out the projected work in conjunction with which they hope to establish a system of public and private electric lighting for Dundalk. It is proposed to run the tramway from the railway station, *viâ* Anne Street, Park Street, Earl Street, Barrack Street, Quay Street, Point Road, and Red Barns, to Blackrock, a popular seaside resort, about four miles distant from the town. Another branch of the projected line goes from Market Square through Clanbrassil Street and other principal streets, and has its terminus at St. Nicholas's Church in Bridge Street. The scheme is regarded favourably by the Town Board and other local bodies.

Glasgow.—Mr. John Young, general manager, and Mr. William Clark, the engineer of the Tramway Department, who recently visited the United States and Canada for the purpose of investigating the various forms of tramway traction, have submitted their report to the Corporation Tramway Committee. We have not space to give this report in full, but, in conclusion, it confirms the recommendation of the sub-committee of July last, which reads:—"That, having carefully considered the whole question, we recommend that the route from Mitchell Street to Springburn be equipped for overhead electric traction as indicated, and that with a view to providing in this way for the necessary augmentation of the service, which is sure to be required next spring, it be remitted to the Tramways Committee with powers to equip this route accordingly as soon as they conveniently can."

Motor Car Items.—Lord Balfour, Secretary for Scotland, has issued regulations, applicable to Scotland, under the Locomotives on Highways Act, 1896, with respect to the use of light locomotives on highways and their construction and the conditions under which they may be used. Article 4 of the regulations states that a person driving or in charge of a light locomotive when used on the highway "shall not, under any circumstances, drive the light locomotive at a greater speed than 10 miles an hour. If the weight unladen of the light locomotive is one ton and a half and does not exceed two tons, he shall not drive the same at a greater speed than eight miles an hour, or if such weight exceeds two tons at a greater speed than five miles an hour. Provided that whatever may be the weight of the light locomotive, if it is used on any highway to draw any vehicle he shall not, under any circumstances, drive it a greater speed than six miles an hour. Provided also that this regulation shall only have effect during six months from the date hereof, and thereafter until the Secretary for Scotland otherwise directs."

In response to the invitation of the Dublin Bread Company, Limited, for estimates for the supply of a motor van, the following tenders were sent in:—

Cutting Bros., Derby	£373
Arnold's Motor Carriage Company, East Peckham ..	350
Watford Engineering Works, Watford	275
Gerhardt & Ohlme, Leipzig-Lindenau	250
New & Mayne, Westminster	250

Reading.—The tramways question was under consideration at the Town Council meeting last week. The following recommendation of the Finance and General Purposes Committee was adopted:—"That the Council being the Local Authority and the Road Authority under the Tramways Act, 1870, do not consent to the proposed scheme for Tramways indicated in the Parliamentary Notice now submitted to the Committee, for the reason, amongst others, that it appears that if such consent were given, and the proposed new system of tramways were authorised by Provisional Order confirmed by Parliament, the powers and privileges of the Corporation with respect to the purchase of the existing tramways after August 16th, 1899, would be postponed and otherwise prejudicially affected. That the retaining by the town clerk of Messrs. Sharpe & Co., of 9, Bridge Street, Westminster, to act as Parliamentary agents for the Corporation in the matter be approved. That the borough engineer and surveyor do report as to the various systems of traction, other than animal traction, available for the working of street tramways, and their comparative suitability for tramways in the streets of this Borough, particularly the streets included in the proposed scheme of the Reading Tramways Company."

The Bordeaux Electric Tramways.—It seems to be rather a prevalent custom in the leading French towns and cities to give electric tramway concessions in each place or district to a number of different interests or applicants, and Bordeaux forms no exception to this system of splitting up a big monopoly into a number of small ones. There are at any rate several concessions for electric tramways in this rich and populous district now being discussed by the municipal authorities, and in a recent issue of the *Revue Pratique de l'Electricité* we find an abstract of the chief points and conditions agreed upon by the city engineers and other officials as representing the *modus vivendi* for any such developments. Amongst them we note the following: Steel rails are to be employed, with metre or standard gauges as may be thought best. Any system of electric traction may be used, accumulators, trolley wires or conduits; the first-named may be employed freely throughout the city, but trolley wires are forbidden over a certain area near the cathedral. The cars—equipped so as to run upon any of the lines—are to be lighted by electricity and furnished with seats for 40 or 50 passengers. The municipality reserves to itself the right of authorising top seats on the cars. Proper schedules or time tables are to be prepared and maintained; the car headway being at least 15 minutes before 8 a.m. and after 8 p.m., and 5 minutes between these hours. Either two classes or a single one may be employed; the tariff with two must be 1½d. and 2d., with one, 1½d.—"correspondances" or transfers being provided for in each case. From 5 to 6 a.m. and from 6 to 7 p.m. workmen's cars are to be run, at fares equal to 1d. the single trip, and 1½d. both ways, or 2d. with transfer. The municipality has the right of dictating to each concessionist at any time the provision of such improvements as it shall consider useful or necessary, on condition that the concessionist's expenses are not thereby increased. If they are, then the town will pay, or prolong the concession. The right of plying for hire is to be paid for at the rate of $\frac{3}{100}$d. for each passenger carried, besides which each concession has to pay to the town a proportion of the gross receipts over and above £2,560 per mile of line, such proportion being stated in each application. Every facility must be given by the tramway authorities to the city officers in their examination of books, papers, &c., so as to arrive at the amount of payment due. The concessionist is responsible for all damage done in constructing the lines; is to pay all *octroi* duties, and establish his works and depôts in Bordeaux. He must also declare whether he intends or not wholly to employ a French staff, plant, and material; he must water the streets at his own expense, and sprinkle salt thereon in winter for melting the snow. Finally, to show that democracy rules, it is laid down that a minimum wage of 5 francs shall be paid, with a maximum day's work of 10 hours; one day's rest is to be given in the week without deducting pay, and a pension fund is to be started at the expense of the tramway interests. The annual pensions after 25 to 30 years of service are to range from £32 to £160. The pension funds are payable into the National Bank for Pensions. With all this care for the citizens and employees, it is to be hoped that the one will ride often enough and the other work faithfully enough for the tramway companies to prosper in at least a sufficient measure for the shareholders also to have some reward.

Claim against the Central London Railway.—At the London Sheriffs' Court last week, before Mr. Under-Sheriff Burchell and a special jury, the case of Messrs. Richardson *v.* the Central London Railway Company, Limited, came on for hearing. It was an action to recover the sum of £16,000 as compensation for the compulsory acquirement of four acres of land at Wood Lane, Shepherd's Bush. The jury gave a verdict for £7,010.

Spain.—The electric tramway between Bilbao and Las Arenas has just been opened for traffic. A concession has just been granted for the construction of several electric tramways at Barcelona.

TELEGRAPH AND TELEPHONE NOTES.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Brest-St. Pierre (Anglo, 1869)	April 6th, 1895 ...	...
Puerto Plata-Martinique ...	Dec. 19th, 1895 ...	...
Amazon Company's cable Obidos-Itacatiara.		
Section: Parintins-Itacatiara	May 5th, 1896 ...	...
Section: Obidos-Parintins	Dec. 7th, 1896 ...	...
Pará-Maranham	Oct. 8th, 1896 ...	...
Maranham-Ceara	Dec. 2nd, 1896 ...	...
St. Lucia-St. Vincent ...	Nov. 30th, 1896 ...	...
St. Croix-Trinidad	Nov. 30th, 1896 ...	...

November 30th, 1896.—Delay of 12 hours on telegrams for St. Vincent, Barbados, Grenada, Trinidad, and Demerara, which are sent by boat.

Souakim-Dejdda	Dec. 5th, 1896 ...	
Landlines.		
Trans-Continental line beyond Masol	March 12th, 1896 ...	...
Carthagena - Barranquilla (Columbia)	July 4th, 1896 ...	...
Salisbury-Umtali	July 11th, 1896 ...	...
Saigon-Bangkok	Dec. 7th, 1896 ...	Dec. 8th, 1896.

December 5th, 1896.—Katarina-Larissa route working badly.

Interruption.—The Post Office on Tuesday gave notice of considerable delay to Spain by all routes except Vigo and Cadiz, *viâ* Eastern Barcelona, *viâ* Marseilles cable and Bilbao, *viâ* Direct Spanish.

Reduction of Telegraph Rates to the East.—In the report of a meeting of the Liverpool Chamber of Commerce held at the beginning of this month, we find the following: "The most important matter which came before them from time to time was the reduction of the cable rates. The committee were pleased that a reduction had been secured in the rates of cable to Japan from 8s. 4d. by the northern route to 6s. 2d. The Eastern Company's charge was 10s. 8d., but they intended to make a reduction which was not, however, yet stated. This arrangement will not come into use until July next. The committee had also had under consideration the question of revising the cable rate to India, and they had had a hint thrown out that something would be done in the matter, and they could depend upon it that it would not be forgotten." From this our readers will see that the managers of the northern route, which consists principally of a landline running across Russia and Siberia, have seen it advisable to reduce the high rates, against the burden of which English merchants have so long, and hitherto so vainly, protested. It may be that this result has been brought about by the proposed establishment in the near future of a competing line, which it is proposed to lay from San Francisco to Japan, and for the purposes of which a Bill was reported to the United States House of Representatives a few months ago, authorising the United States Postmaster-General to enter into the necessary contracts. That the managers of the northern route have shown a prudent provision as regards Japan is undeniable, but in strong contrast to this is the action of the joint telegraph companies as regards Hong Kong; this has been most severely criticised and protested against at a meeting of the Hong Kong General Chamber of Commerce,* held some two months ago. At this meeting it was pointed out that having been successful in concluding a convention with the Chinese Telegraph Administration, the companies concerned have been enabled, "at one day's notice, to raise and exact rates which cannot but be regarded as excessive and injurious to the best interests of foreign trade and commerce." It was further stated that the convention "gives the telegraph companies an absolute monopoly, which was immediately utilised by the companies to the extent of 37½ per cent. to Europe, 43·6 per cent. to America, and 100 per cent. on local messages." With the above strong protest before us, it is interesting to remember that on the approach of competition one of the telegraph companies above referred to (the Eastern Extension, China, and Australasian Telegraph Company), put forth an appeal *ad misericordiam* to the English public, on the ground that a "pioneer" company deserved more consideration. In the present case, however, it is to the United States Congress that this plaintive appeal must be made—with what result it is not difficult to imagine.

* We are not in a position to say whether rates to Hong Kong by the northern route have been reduced since the meeting referred to was held.

The Commercial Cable Company.—There has been a demand for Postal and Commercial Cable shares. Private telegrams from Montreal have been speaking positively of the prospect of an immediate amalgamation of the two concerns, and now it is positively stated that Postal shares are to be exchanged for 4 per cent. bonds of the Commercial Company. Further, the Commercial Company is paying an extra dividend of 1 per cent., making the rate 8 per cent. for 1896. The amount to be issued by the Commercial Cable Company for the purchase of the Postal telegraph system in the United States and Canada is reckoned at $15,000,000, or, say, £3,000,000. The present capital of the Commercial Cable Company is $10,000,000, or, say, £2,000,000, so that £5,000,000 will be the capital when the two concerns are amalgamated.

The "Deutsche See-Telegraphen-Gesellschaft."—At the ordinary half-yearly meeting of the Brazilian Submarine Telegraph Company held in May last, the acting chairman announced that "with their allies, the Eastern Telegraph Company, and with the Telegraph Construction and Maintenance Company, they had also joined in a new concern, called the German Telegraph Company, having for its object the laying of a cable from Emden, in Germany, to Vigo, in Spain. Shortly after this announcement was made, we pointed out to our readers the probable opposition to existing Atlantic lines which might arise from this action. We now learn from a Berne circular that the company referred to by the chairman of the Brazilian Submarine Telegraph Company, is acting under a concession from the German Empire, under the name of the "Deutsche See-Telegraphen-Gesellschaft," the headquarters being at Cologne. It is intended that the cable will connect the lines of the German Administration at Borkum on the one hand, and the Eastern Company's cables and the Spanish landline system at Vigo on the other hand. This Emden-Vigo cable will, to a great extent, relieve the English Government lines of through traffic from the Continent, which they have hitherto carried. It is expected that this cable will shortly be completed; indeed, had it not been for an unforeseen series of accidents, it should have been finished quite a month ago. Bad weather in the German ocean, a serious explosion on board the ss. *Scotia* on her first trip, followed by a collision when starting from her moorings to complete the work, has necessitated the transfer of a portion of the cable to another cable ship, the ss. *Calabria*, pending the necessary repairs to the ss. *Scotia*. We hope, however, that these troubles are now approaching an end, and that before Christmas the "Deutsche See-Telegraphen-Gesellschaft" will begin to reap the benefit of their enterprise.

Telegraph Rates between Canada and the East.—At a meeting of the Toronto Board of Trade Council held in Canada recently, a petition was received from the Hong Kong Chamber of Commerce in reference to the raising of telegraphic rates—to Europe 97½ per cent., to America 43 per cent., and between Hong Kong and Shanghai 100 per cent. It asked the Board to lend all the assistance in its power to any scheme for laying a cable across the Pacific either from some point in Canada or the United States *viâ* Honolulu and Japan to China and Hong Kong, in order that the cost of communication might be reduced by healthy competition. The Council decided, says the *Canadian Gazette*, to acknowledge the petition, and appeared to be labouring under the misapprehension that a direct cable service to China and Japan *viâ* Canada is now under consideration in England. The scheme now being investigated is, of course, for a cable *viâ* Canada to Australasia.

CONTRACTS OPEN AND CLOSED.

OPEN.

Camberwell.—December 14th. The Vestry Baths Committee invites tenders for the renewal, &c., of 45 accumulators in connection with the electric lighting of their baths and washhouses in Church Street, Camberwell. See our "Official Notices" for further details.

Denton.—Messrs. John Lever & Co. of Denton, Lancs., are inviting tenders and specifications for an electric lighting installation.

France.—January 31st. Tenders are being invited until January 31st next, for the contract for an installation of electric lighting in the Asile d'Aliénés at Saint Jvon (Seine Inférieure).

Harrogate.—January 1st, 1897. The Council wants tenders for wiring the Municipal Offices, Victoria Baths, Market Hall and Public Library, also for electrical fittings for the same. See our "Official Notices" for further particulars.

Islington.—December 16th. The Vestry invites tenders for the supply of certain machine, smith's and engineer's tools. See our "Official Notices."

Spain.—December 16th. The General Direction of the Spanish Posts and Telegraphs in Madrid is inviting tenders for the supply of 20 tons of bronze telegraph wire. Tenders to be sent to the Direccion Général de Correos y Telegrafos, Calle de Carretas, 10, Madrid.

Wakefield.—December 14th. Tenders are invited by the West Riding County Council for the maintenance and renewal of the electrical recording stations, signals, bells, and telephones at the Wakefield Asylum. Particulars from Mr. J. S. Banks, Clerk of Works, The Asylum.

CLOSED.

Bradford.—It is stated by a contemporary that the Town Council has accepted the tender of Messrs. Rosling & Appleby, for the supply of 18 continuous current motors.

France.—The contract for the electric lighting of the little town of Cazeres-sur-Garonne (Haute Garonne) has been placed with Messrs. Mathelin & Garnier, Paris.

Hastings.—We learn from *Daily Tenders* that the Council has accepted the following tenders:—Babcock & Wilcox, Limited, boilers, £854; Crompton & Co., Limited, electrical plant, £2,231.

Southampton.—In our last issue we stated that the protecting estimate of Mr. J. H. Lee, the electrical engineer, for the wiring of the Municipal Offices, Guildhall, and Police Offices was £554. We are asked to state that his figure was £354.

South Shields.—The Council has accepted Messrs. Ferranti's tender for the extension of plant required here:—Steam alternators and transformers, £5,412 10s., and rectifiers and switchboard, £589.

West Ham.—We have received the following list of tenders opened by the School Board on November 17th, 1896, for electric wiring at the Water Lane Pupil Teacher's Centre:—

	£	s.
Edmundson & Co.	492	0
Vulcan Electric Co.	194	0
Vaughan & Brown..	630	0
Moody Bros...	504	16
Strode & Co...	493	
Rashleigh Phipps & Co.	536	
Architect's estimate	250	

Some of the figures appear extraordinary!

West Ham.—Mr. Steinitz, the borough electrical engineer, informs us that 97 tenders were sent in as the result of advertisements appearing in the technical papers. The Council have adopted the tenders of the following firms:—

Section A.—Messrs. S. Z. de Ferranti, Limited, steam alternators and exciters	£9,600	0
„ B.—Messrs. W. H. Allen, Son & Co., surface condenser and pumps	650	0
„ C.—Messrs. S. Z. de Ferranti, Ltd., station switchboard, &c.	633	0
„ D.—Messrs. The British Insulated Wire Company, H. and L. T. cable, &c.	8,094	11
„ E.—The Brush Company, Limited, trans. sub-stations and transformers	1,453	10
„ F.—The General Electric Company, instruments	260	10
„ G.—Messrs. Drake & Gorham, arc lamps, posts and transformers	2,530	0
H.—Messrs. Taylor & Hubbard, 10-ton crane	246	0

NOTES.

Fluorescent Screens for Röntgen Rays.—R. W. Buttemer, writing in *Photography*, recently gave the following instructions for making a fluorescent screen:—Brush over a piece of black card with gum, and sift the salt over it. The writer has used this method with calcium tungstate (scheelite); but this salt, though brilliant, phosphoresces as well as fluoresces, thus giving a foggy image after a few consecutive trials. Or, mix the powdered salt with collodion (flexible, *i.e.*, containing a percentage of castor oil), and coat the card or aluminium foil with it. The writer found this method most successful with barium platino-cyanide on aluminium foil. Or, coat the card or foil with dilute flexible collodion, and sift the salt over it. He has used this method with Melckebeke and Van Heurck's fluorescent salt, which appears to be an organic salt of uranium. But in all cases success depends on finely powdering and sifting the (carefully dried, if necessary) salt. He used 120 to 1 inch.

Charge of Fraud.—In the charge brought against Charles Finn, electrical engineer, for obtaining money by false pretences, further evidence was given on Saturday last at the Thames Police Court, and the case adjourned.

The Institution of Electrical Engineers.—At the annual general meeting, held yesterday, 10th inst., the annual report of the Council was presented, also the statement of accounts and balance-sheet for the nine months ending September 30th, 1896. Council and officers for the year 1897 were elected.

The statement of receipts and expenditure for the nine months ending September 30th, 1896, shows that the balance carried to general fund, being excess of receipts over expenditure, amount to £887 19s. 6d., the receipts being £3,011, and the expenditure, £2,123. The "building fund" now stands at £3,528, and £3,500 of this is invested in safe securities.

Electric Lighting of the Avenue de l'Opéra, Paris.—It will be remembered that in 1878 the Avenue de l'Opéra was lighted electrically, as an experiment, by means of Jablochkoff candles, by the Jablochkoff Company. The municipal service is now engaged in the installation of a new system of lighting by means of 48 arc lamps. These arc lamps are arranged in candelabra at a height of 5·5 metres, and are of the type adopted by the City of Paris. Forty-four candelabra arranged in groups of five are placed 22 on the right and 22 on the left, and four are placed on refuges in the middle of the road. The arc lamps will be fed by the alternating current supplied from the Halles municipal station. It will be remembered that the shopkeepers of the Belle Jardinière did not wish to be supplied again from the municipal station, and it was in order to utilise the Ferranti machine, which was left unemployed, that the lighting of the Avenue de l'Opéra was undertaken. The arc lamps, of 10 amperes, will be connected four in series on 220 volts furnished by two transformers coupled in series. The transformers will be placed in a little kiosk in a neighbouring street, the Rue des Petits-Champs. The lower part of this kiosk will contain the distribution board and the accessory apparatus for the lighting. The installation will soon be completed, and the lighting will shortly commence.

American Motor Cars.—Commenting upon the race at Providence, the *Electrical Journal* of Chicago considers that the best friends of the motor car are those who deprecate high speeds. Like the Brighton race, the race at Providence did no real good to the motor car. Any desired speed can be obtained; but it is not speed that makes further success of the motor car so much as certain conditions of safety and endurance and hill-climbing. The Providence race was a race pure and simple, and the winners were electrical cars, for the race was one of 5 miles only, and was not a test of endurance at all. Three heats of 5 miles were run on three successive days, and the electric cars came out first every time, but the gasolene vehicles were not geared for speed, but for service. The winning car, that of the Riker Electric Company, did the 5 miles in 11 min. 27 secs. The road was hard and level. The performance of all kinds of cars in England, France and America, is in itself amply sufficient to show the emptiness of the claim made by the British Motor Syndicate, of a monopoly of all valuable inventions. The syndicate do not hold a single patent which has shown in practice any superiority over many other cars that would be competitors for public favour.

Glow Lamp Standards.—The following proposals have been made by a commission of the *Verband der Deutscher Elektrotechniker*, and apply to lamps of 60—70 and 95—125 volts, consuming 3-4 watts per candle (Hefner lamp), and giving 10, 16, 25 and 32 candles (Hefner lamp) total luminous intensity:—1. The lamps are marked with the voltage which corresponds to the candle-power also marked upon them. A deviation is allowed of 2 per cent. above or below the tension asked for. The lamps are to be tested with the voltage marked. A deviation of 6 per cent. above or below the standard candle-power (marked on the lamp), and also above and below the standard watts per candle-power is permissible. If more than a quarter of the lamps submitted to the test are found to overstep these limits, the consignment may be returned. 2. The life of a lamp is to be reckoned by the number of hours it burns before it has fallen 20 per cent. below the standard candle-power. The mean life of the lamps must be given by the lamp factory. 3. The photometric measurements are carried out as prescribed by the sub-commission. 4. Objection to the quality of a consignment of glow lamps is permissible if made within 30 days of delivery, but only if 2 per cent., or at least 20 lamps are still left to be tested. The decision as to who shall carry out the tests will, if possible, be made by agreement between the contracting parties; but if they cannot agree, the physical-technical Reichsanstalt shall decide. The cost of the procedure shall be paid by the losing party. 5. The glow lamp commission recommends the introduction of the Edison screw socket for all lamps. 6. A certificate guaranteeing the fulfilment of the above conditions is to be sent by the manufacturer with each consignment of lamps. [*Elek. Zeitsch.*, 17, p. 685.]

The Institution of Marine Engineers.—On Friday evening last this Institution gave its eighth *conversazione* in the Town Hall, Stratford. From 6.30 till 8 o'clock the savage breasts of the amphibious beings y'clept marine engineers were soothed, it is to be hoped, by the charms of the divine art over which the Muses preside, although we have reason to believe that they had a decided preference for the music of their own voices. Shortly after 8 o'clock Sir Edward Sandys Dawes, K.C.M.G., delivered his presidential address, his subject being divided into four heads, viz.:—The Defence of the Empire, the Progress of Commerce, Colonial Expansion, and the Food Supplies of the United Kingdom and the products essential for its industrial enterprises. Then, while Mr. H. L. Balfour, one of the first executants in the kingdom, gave a short organ recital, the spacious hall was cleared for dancing, and the engineers leaving for the nonce their sea legs behind them, indulged, with their fair partners, in the excitement of the "light fantastic toe" until the small hours of the next morning. Exhibits were lent by Mr. Wimshurst, the Electric Welding Company, and Mr. A. A. Campbell Swinton, and amongst those present we noticed Mr. J. Macfarlane Gray, Mr. Durston, R.N.C.B., Mr. R. Wallis-Jones, and Mr. William I. Taylor, of Messrs. Clarke, Chapman & Co., Limited, to whom, we believe, by virtue of his office as Convener of the Institution for the year, the whole success of the entertainment was due.

Flexible Cords and Fire.—The fire danger lurking in electric flexible cord connections is practically demonstrated every now and then, and with it, too, the need of better cords. In a recent instance mentioned in a fire underwriters' report, a flexible cord, supporting a lamp which was not burning at the time, suddenly developed, says *Cassier's Magazine*, a short circuit and a 1-ampere fuse in a rosette opened, cutting off the current. The cord was quite greasy with oil coming from shafts and bearings, and dirty with lint which had accumulated. The risk was a cotton mill. The arc, though almost instantly cut off, was sufficient to set the cord on fire, and several inches of it were burned. The fire was quickly extinguished by an attendant, so that practically no damage was done. A few days before this accident another cord developed a short circuit under practically the same conditions. In both cases the cords were hanging free in the air and had not been touched for a number of hours. It is the custom at this mill to frequently turn on and off the lamps by the key sockets and also to frequently brush the lint off the cords. During the summer season the cords are wrapped together and tied in a bunch near the ceiling to get them out of the way. The best explanation of the trouble is that a strand of the fine wire broke and pushed its sharp end through the insulation causing the short circuit. Both cords had one or two layers of cotton thread first, then a fairly thick outer covering of silk, but they were not rubber covered. These occurrences show, says our contemporary, that however quickly currents may be cut off by fuses, the heat generated by the arc is sufficient to set fire to flexible cords, especially if they are at all greasy and covered with lint. A better cord may not mean one having a higher insulation, but rather one which could not be set on fire. It seems important that cord should be used which would prevent short circuits occurring under as great a number of conditions as possible, and at the same time prevent the flash produced by a short circuit from doing harm.

Small Alternating Dynamo.—A friend writes:—"Can you tell me where I can get a small alternating dynamo to give about 8 volts. A Siemens H armature with permanent magnet would, I think, be best. It is required to develop only about 4 watts, so that it could be driven by a small water motor or hot air engine. I want to produce a sinusoidal current, frequency 100 per second, and E.M.F. 5 to 8 volts." Can any of our readers give the information required?

Award.—The Council of the Society of Arts have awarded the Fothergill prize of £25 and a silver medal for a paper on "The Best Means of Effectually preventing the Leakage of Current to Earth in Electrical Installations from Generating Heat and Setting Buildings on Fire," to Frederick Bathurst, A.Inst.E.E. The paper will be read at one of the Wednesday evening meetings after Christmas.

Practical Method for Compounding a Shunt Dynamo.—Mr. A. F. McKissick, in the *American Electrician*, gives the following very simple and accurate method for compounding a shunt dynamo so as to give a constant potential at the brushes for all loads:—Wind over the shunt fields a known number, S, of turns of rather heavy wire and connect, in series with an ammeter and a variable resistance, to the terminals of an outside source (not the dynamo under test). The machine is started up (with the circuit of added turns open) and the field rheostat adjusted to give normal potential at no load. Full load is added to machine, which causes the voltage at the brushes to drop. Sufficient current is sent through the extra turns in the right direction to build the voltage up to normal, and the values of the current in the extra turns, C, and that in the mains, C′, noted. Then the number of series turns to be added are:

$$\frac{S\,C}{C'}.$$

The above applies to dynamos of the single horse-shoe or salient type. For a consequent pole type machine (*e.g.*, the Manchester type), wind on each limb an equal number of turns, and connect so that these extra turns assist the shunt turns. Then S equals total number of turns added, and the calculation is the same as above.

Royal Institution.—The following are among the lecture arrangements before Easter, 1897:—Prof. Silvanus P. Thompson, six lectures (adapted to a juvenile auditory) on "Light, Visible and Invisible;" Prof. Augustus D. Waller, 12 lectures on "Animal Electricity;" and Hon. Lord Rayleigh, six lectures on "Electricity and Electrical Vibrations." The Friday evening meetings will begin on January 22nd, when a discourse will be given by Prof. Dewar. Succeeding discourses will probably be given by Prof. Jagadis Chunder Bose, Dr. G. Johnstone Stoney, Mr. Shelford Bidwell, the Right Hon. Lord Rayleigh, and other gentlemen.

A general monthly meeting of the members of the Royal Institution was held on 7th inst., Sir James Crichton-Browne, M.D., F.R.S., presiding. The following were elected members:—The Hon. and Rev. William Byron, Sir Gervas Powell Glyn, Bart., Dr. Alexander Scott, Mrs. T. B. Sowerby, and the Rev. Samuel A. Thompson-Yates. The special thanks of the members were returned to the Duke of Northumberland, K.G., President of the Institution, for a donation of £200 to the fund for the promotion of experimental research at low temperatures; to Colonel Coleridge Grove for a bust of his father, the late Sir William Grove, M.R.I.; and also to Prof. Dewar for a marble pedestal for the bust.

His Royal Highness the Prince of Wales has consented to open, on Tuesday afternoon, December 22nd, 1896, the Davy-Faraday Research Laboratory of the Royal Institution, founded by Dr. Ludwig Mond, F.R.S., as a memorial of Davy and Faraday. The ceremony will take place in the Theatre of the Royal Institution, where, by desire of His Royal Highness, Prof. Dewar will, after the opening ceremony, show experiments illustrative of the use of liquid air in scientific research.

Fatalities.—While some men engaged by Messrs. G. Hill and Co. were employed putting electric wires in some Manchester premises, one of them, who was standing on a scaffold, was somehow caught in some machinery and killed.

An electric car and a railway parcels van collided at Hartlepool the other day, the driver of the latter vehicle being killed. At the inquest it was stated that the horse took fright.

The Brighton Seashore Railway.—This electric railway, which we described a fortnight ago, was very disastrously affected by the storms at the end of last week. The directors of the company have decided, in consequence of the damage, to repair the line, to rebuild the car which was greatly damaged, to reconstruct the power station, to order an additional car, and to make provision for the safe accommodation of the cars in future. Volk's electric railway at Brighton was also very much injured. Much sympathy is being extended to Mr. Magnus Volk locally, his personal loss being very great. The *Sussex Daily News* has opened a fund.

Acetylene as a Photometric Unit.—We are not at all surprised to find that acetylene has been proposed as a suitable source of light in photometry. Those who are familiar with the ordinary flame of acetylene must have noticed its brilliance and whiteness, and since it is possible to produce this gas in a pure condition, it is clear that in using it for photometry we should be using a substance of uniform character. All that has to be guarded against is to see that the conditions under which the gas is burnt, pressure, access to air, size and shape of burner, &c., should be uniform. At a recent meeting of the Paris Academy of Science, Jules Violle called attention to the value of acetylene as a photometric unit. He stated that when acetylene is burnt under a somewhat high pressure, in a burner which produces a broad, thin flame, a very brilliant and remarkably white light, of constant intensity, is obtained, the illuminating power being practically uniform over a large area. By placing in front of the flame a screen pierced with an aperture or apertures of definite dimensions, very convenient photometric units can be obtained. The intensity of the flame is about 20 times that of the flame from an equal volume of coal gas burnt in an ordinary burner, and at least six times as great as that of the coal gas burnt in an incandescent burner. In spectroscopic character, the light from the acetylene frame differs very little from that emitted by melting platinum. The original paper may be found in the *Comptes Rendus*, 1896, Vol. cxxii., pages 79 and 80.

The Manufacture of Chlorine and Zinc from Blende.—An interesting application of electrolysis has been made by F. M. Lyte, who succeeded in producing chlorine and zinc from the mixed ores of blende and galena. The blende is roasted, and the product lixiviated with dilute sulphuric acid, and the solution of zinc sulphate, after purification, treated with calcium or sodium chloride. After separation of the calcium or sodium sulphate formed, the solution of zinc chloride is evaporated to dryness, and is then subjected to distillation to separate from non-volatile impurities. The zinc chloride is now heated to a temperature slightly above the melting point of zinc, and is then electrolysed, an anode of carbon and a cathode of fused zinc being used. As the zinc accumulates in the cell, it is automatically siphoned off. The chlorine set free is liquefied and stored. The residual galena from the treated ore is then worked by the well-known processes for obtaining lead and any precious metals that it may contain.

Machine Telegraphy.—Along with Mr. P. B. Delany's letter which we published last week, we received a specimen of the record referred to. We now give a copy of this, as it may interest telegraph men.

Leeds Association of Engineers.—The 31st annual dinner of this Association was held on Saturday evening last at the Queen's Hotel, Leeds. Mr. T. Purvis Reay presided, and Mr. E. E. Lawson was in the vice-chair. Amongst those present were the Mayor of Leeds (Sir James Kitson, Bart., M.P.), the Right Hon. H. J. Gladstone, M.P., and Mr. James Bowers (President of the Association).

Battery Hydrometer.—Mr. Alfred E. Dean, of Hatton Garden, has sent us a new form of battery hydrometer, of which he is the inventor. It is intended to replace the long spindle hydrometer which requires so much acid to float it, and which hitherto has not been produced sufficiently narrow to allow it to float between the plates of storage batteries. It is also particularly adaptable to small and portable accumulators, as it can be made as narrow as $\frac{1}{8}$th inch diameter, and of any capacity above it.

Central Station Insurance.—The Bedford Local Authority, acting upon the advice of its Electric Light Committee, has decided not to insure the electric light station, as with the increased premiums it would cost £39 12s. for six months. The electrical engineer assured the Committee that the station was perfectly safe; and the timber in the roof was the only thing that could catch fire.

A Future for Alkalis prepared by Electrolysis.—In the thirty-second annual report on alkali, &c., works, a promising future is inadvertently foreshadowed for the electrolytic processes of manufacturing alkali. The report is by Mr. R. Forbes Carpenter, who succeeded Mr. Fletcher in the office of Chief Inspector under the Alkali Works Act in June, 1895. He follows the lines laid down by the first inspector, Dr. R. Angus Smith, and his successor. Of the present report, 97 pages are devoted to England, Ireland, and Wales, treated as seven districts, and the remaining nine pages are given to Scotland in a separate communication. In this report, the following table is given of the :—

Salt Decomposed in the Leblanc and Ammonia Soda Processes (Including Scotland).

	1895. Tons.	1894. Tons.	1893. Tons.
Leblanc process ...	408,173	434,298	467,562
Ammonia-soda	428,614	361,603	349,609
Total	836,787	795,901	817,171

Here the steady gain of the new process upon the old is clearly shown, and soon, it would appear, both processes are likely to have a new competitor in the electrical process, preparations for working which are being made by the Electro-Chemical Company at St. Helens, using Holland and Richardson's process; by the Castner-Kellner Alkali Company, and by Hargreaves & Bird's process for the production of alkali and chlorine, already worked out on the experimental scale at Farnworth. In obtaining alkali carbonate by this process, the voltage was so low as 3·2 to 3·5, but on working for alkali as caustic, the voltage rises, and Mr. Hargreaves claims "that from a given amount of electrical energy a greater aggregate market value is produced when working for carbonate of soda and injecting carbonic acid into the empty cathode compartments, than when working for caustic." The carbonic acid required is obtainable from the exhaust of the gas engine employed to run the dynamo. This report, from a disinterested observer, is distinctly encouraging, and those who have for so long been experimenting with electrolysis as a means for producing alkalis, will doubtless take heart of grace from it.

The Dielectric Constant of Liquid Mixtures.—Determinations of the dielectric constants in the case of various liquid mixtures have recently been made by C. E. Linebarger. Determinations were carried out on the following mixtures :—Benzene | ether; benzene | ethylic acetate; benzene | carbon tetrachloride; toluene | ethylic benzoate; toluene | turpentine; toluene | carbon bisulphide; chloroform | carbon tetrachloride; carbon bisulphide | chloroform; carbon bisulphide | ether. In no case can the constant be accurately calculated by the simple mixture rule, the actual numbers being lower than the calculated in all cases except in those mixtures where ether was one of the components, when the reverse obtained. The dielectric constants were determined by the method described by Nernst, in the *Zeitschrift für Chemie*, xiv., pp. 622—663, and duly noticed in the *Journal*. For further particulars, consult the *Zeitschrift der Physikalischen Chemie*, 1896, 20, p. 131—134

Telegraphy without Wires.—To-morrow (Saturday) evening, at 8 o'clock, at Toynbee Hall, Whitechapel, Mr. W. H. Preece, C.B., F.R.S., will deliver a popular lecture on this subject.

The Royal Society.—Before this Society, yesterday, at 4.30 p.m., the following paper was down for reading :—"On Prof. Hermann's Theory of the Capillary Electrometer," by G. J. Burch.

The Institution of Junior Engineers.—To-night (Friday), at 8 p.m., at the Westminster Palace Hotel, a paper on "Electric Central Station Working," will be read by Mr. P. W. McDougall, of Deptford.

Personal.—The Glasgow Philosophical Society has, in celebrating Lord Kelvin's jubilee on 2nd inst., asked him to become an honorary member.

Lectures.—At the Yarmouth Church Club on 2nd inst., Mr. Seabrooke, assistant electrician to the Corporation, read a paper on "Electricity."

At Mount Wise Barracks, Devonport, on Tuesday, Lieut.-Colonel C. F. C. Beresford gave a lecture on "Field Telegraphy."

NEW COMPANIES REGISTERED.

Prince Motor Syndicate, Limited (50,345).—Registered November 30th, capital £50,000 in £1 shares, to adopt an agreement with F. O'C. Prince, to acquire any patents, rights, privileges, &c., and to carry on the business of cycle, carriage, motor, and vehicle manufacturers, electricians, mechanical engineers, machinists, fitters, founders, wire drawers, tube makers, &c. The subscribers (with one share each) are:—E. Benedict, M.I.C.E., 18, Margravine Gardens, West Kensington; J. St. Patrick, 147, Leadenhall Street, E.C., accountant; E. McColl, Pelham Place, Crumpsall, accountant; S. H. Brooks, 7, Percy Street, W., artist; J. E. Hunter, Wensley House, West Kensington, captain R.N.; C. C. Waterford, 35, Turret Grove, Clapham, S.W., secretary; F. O'C. Prince, 37, Cursitor Street, W.C., civil engineer. The number of directors not to be less than three nor more than seven; the subscribers are to appoint the first; remuneration £100 each per annum and a share in the profits. Registered by W. & W. Stocken, 48, Lime Street, E.C.

New Traffic Syndicate, Limited (50,355).—Registered December 1st; capital, £12,000 in £1 shares, to promote the interests of the movement of industry of placing motor vans, motor waggons, and all kinds of mechanically-propelled vehicles on the common roads, and to carry on the business of electricians, cycle motor and carriage manufacturers, engineers, machinists, fitters, founders, &c. The subscribers (with one share each) are: W. F. L. Peacock, 8, Maryland Road, W., clerk; F. S. Gaylow, 74, Stockwell Park Road, S.W., clerk; T. G. Norris, 32, Graces Road, Camberwell, clerk; G. H. Sanderson, 40, Grafton Road, Kentish Town, N.W., clerk; J. Hattersley, 173, Harrow Road, Leytonstone, clerk: J. P. Eldridge, 7, Brunswick Avenue, New Southgate, clerk; J. W. H. Walch, 60, Barcombe Avenue, Streatham, clerk. Registered without articles of association by J. P. Eldridge, 7, Brunswick Avenue, New Southgate.

Conrad Dewey & Co., Limited (50,372).—Registered December 2nd, capital £2,000 in £1 shares, to supply all fittings and glass in connection with gas, oil, and electric lighting. The subscribers (with one share each) are:—C. Dewey, 102, Walworth Road, S.E., merchant; S. Dewey, 102, Walworth Road, S.E., merchant; R. Dewey, 102, Walworth Road, S.E., gentleman; N. R. Dewey, 102, Walworth Road, S.E., gentleman; P. E. Dewey, 25, Crampton Street, S.E., merchant; E. R. Dewey, 25, Crampton Street, S.E.; R. H. Dewey, 71, Shoe Lane, E.C., merchant. Registered, without articles of association, by C. Dewey, 102, Walworth Road, S.E.

South London Electric Supply Corporation, Limited (50,392).—Registered December 4th with capital £325,000, in £5 shares, to adopt agreements with Manlove, Alliott & Co., Limited, British Insulated Wire Company, Limited, and S. Z. de Ferranti, Limited, to acquire C. W. Sax's interest in the Lambeth Electric Lighting Order, 1892, and to supply electricity in Lambeth and elsewhere. The subscribers (with one share each) are:—W. T. Carter, 9, Brandon Street, Gravesend, engineer; W. S. Mackenzie, Constantine Road, Hampstead, clerk; C. Brokenbro, 130, Powerscroft Road, N.E., clerk; C. B. Ince, St. Benet Chambers, Fenchurch Street, solicitor; J. E. Nicol, 26, Colville Road, Leytonstone, accountant; J. O. Ince, 13, Frognal, Hampstead, engineer; W. R. Jackson, 6, Northolme Road, Highbury, writer. The number of directors is not to be less than five, nor more than seven; the subscribers are to appoint the first. Qualification 100 shares; remuneration £1,200 per annum, and a share in the profits divided. Registered by Ince & Co., St. Benet Chambers, Fenchurch Street, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Blackheath and Greenwich District Electric Light Company, Limited (47,875).—This company's statutory return was filed on September 14th; 1,200 shares have been taken up out of a capital of £20,000 in £1 shares, 5s. per share has been called, and £300 paid.

London and Lancashire Electric and General Engineering Company, Limited (38,281).—This company's annual return was filed on November 6th. The capital is £20,000 in £5 shares, and 1,987 have been taken up; 1,000 are considered as paid, and £2 per share has been called on the rest; £1,914 has been paid, and £62 is in arrears, while £2 has been received in respect of two forfeited shares.

Dutton & Co., Limited (29,259).—This company's annual return was filed recently, when 285 shares and 2,810 ordinary shares were taken up out of a capital of £60,000, in £10 shares; 2,200 of these are considered as paid, and the full amount has been called, and £8,950 paid on the remainder.

Milver Portable Electric Battery Syndicate, Limited (44,003).—The registered office of this company has been removed from 47, Vittoria Street, to 27, Vittoria Street, Birmingham.

D. Hulett & Co.—The return of this company to August 27th, filed on September 4th, shows that 5,900 ordinary and 100 founders' shares have been taken up; 4,100 shares are issued as paid, £5 called on the rest, and £9,500 has been paid.

CITY NOTES.

Crompton & Co., Limited.

The following notices have been sent to the shareholders:—

"I am instructed to forward you the accompanying notice of an extraordinary general meeting, which has been called by the directors for the purpose of passing a resolution increasing the borrowing powers of the board from £100,000, which is the present limit, to a maximum of £150,000.

"The activity in the company's business, referred to by the directors in their report of July 18th last, has continued and increased, so much so, that the turnover of the works for the six months ending September 30th last was nearly double the turnover in the corresponding period of the preceding year.

"There is every appearance that this increase of business will continue, particularly as the company has already in negotiation some large contracts for special work, chiefly for electric traction.

"The erection of the new works at Chelmsford progresses rapidly, and there is no doubt when these are completed and occupied, the company's facilities for handling large orders will be very greatly increased, and the work will be turned out not only quicker, but more economically than at present.

"Notwithstanding the difficulties of manufacture in the temporary buildings at the old Arc Works, it may be mentioned that the accounts of the company for the half-year ending September 30th last show a satisfactory profit.

"At the date of the last balance-sheet the amount borrowed by the company had practically reached the limit authorised by the shareholders, and it is solely in consequence of the increase of activity of the company's business, referred to above, that the board now invite the shareholders to sanction an increase of their borrowing powers.

"Yours faithfully,

"Francis R. Reeves, *Secretary*."

"Notice is hereby given that an extraordinary general meeting of the shareholders of Crompton & Co., Limited, will be held at the City Terminus Hotel, Cannon Street, in the City of London, on Monday, December 14th, at 3 o'clock p.m., for the purpose of considering, and if approved, of passing the following resolution:—

"'That the directors be, and they are hereby authorised, to borrow any sum or sums of money on such security, and upon such terms as to interest or otherwise as they may deem fit, provided that the amount borrowed shall not exceed in the whole, without the further sanction of a general meeting of the company, the sum of £150,000.'

"By order of the board,

"Francis R. Reeves, *Secretary*."

Eastern Extension Telegraph Company, Limited.—The coupon on the 5 per cent. Australian Government subsidy debentures, due 1st prox., will be paid on and after that date at Barclay's Bank. Coupons must be left three clear days for examination.—The directors have declared an interim dividend for the quarter ended September 30th of 2s. 6d. per share, free of income-tax, payable on 15th prox.

Commercial Cable Company, Limited.—This company holds a special meeting of shareholders at the offices, Postal Telegraph Buildings, 253, Broadway, New York, on December 22nd, at 11 o'clock. The transfer books closed from 12th to 23rd insts.

Western Union Telegraph Company, Limited.—The declaration of the regular quarterly dividend of 1¼ per cent. is recommended.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending December 6th, 1896, were £1,052; week ending December 8th, 1895, £977; increase, £75; total receipts for half-year, 1896, £21,947; corresponding period, 1895, £20,527; increase, £1,420.

The Great Northern Telegraph Company. The receipts in November, 1896, amounted to £24,000; January 1st to November 30th, 1896, £261,600; corresponding months, 1895, £286,400; corresponding months, 1894, £261,000.

The Liverpool Overhead Railway Company. The receipts for the week ending December 6th, 1896, amounted to £1,069; corresponding week last year, £1,042; increase, £27.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending December 4th, 1896, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £2,804.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1893.	1894.	1895.	Closing Quotation, Dec. 2nd.	Closing Quotation, Dec. 9th.	Business done during week ended Dec. 9th, 1896. Highest.	Lowest.
173,400£	African Direct Teleg., Ltd., 4 % Deb.	100	4 %	4 %	4 %	100 —104	100 —104	101	...
25,000	Amazon Telegraph, Limited, shares...	10	...	...	...	8½— 9½	8½— 9½	...	...
1,012,880£	Anglo-American Teleg., Ltd.	Stock	£2 11s.	£2 2s.	£2 9s.	51 — 54	51 — 54	52	...
2,993,560£	Do. do. 6 % Pref.	Stock	£5 2s.	£4 4s.	£4 18s.	96 — 97	95½— 96½	96⅜	95¼
2,993,560£	Do. do. Defd.	Stock	...	...	...	10 — 10¼	9⅞— 10¼	10⅛	...
130,000	Brazilian Submarine Teleg., Ltd.	10	6½% §	7 %	7 %	14⅜— 15¼	14⅜— 15¼	15⅛	14 13/16
75,000£	Do. do. 5 %, Debs., 2nd series, 1906 ...	100	5 %	5 %	5 %	113 —117	113 —117	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 44,000	5	... §	2½%	4 %	3¼— 3⅜	3¼— 3⅜	...	...
10,000,000$	Commercial Cable Co.	$100	7 %	7 %	7 %	157 —162	165 —170	...	...
224,850	Consolidated Telep. Const. and Main., Ltd. ...	10/-	2 % §	1½%	1½%	1/16— 3/16	1/16— 3/16	...	...
16,000	Cuba Teleg., Ltd.	10	8 %	8 %	8 %	11½— 12½	11½— 12½	12¼	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	18½— 19½	18½— 19½	...	...
12,931	Direct Spanish Teleg., Ltd.	5	4 %	4 %	4 %	3¾— 4¼	3¾— 4¼	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	10 — 10½	10 — 10½	10 7/16	...
30,000£	Do. do. 4½ % Debs. Nos. 1 to 6,000 ...	50	...	4½%	4½%	107 —110 %	107—110%	...	...
60,710	Direct United States Cable, Ltd.	20	2⅝% §	2 %	2¼%	9¼— 9⅜	9¼— 9⅜	9 7/16	9¼
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6¼% §	6¼%	6¼%	17½— 17⅝	17 — 17½	17 7/16	17
70,000	Do. 6 % Cum. Pref.	10	6 % §	6 %	6	17½— 18⅛	17½— 18⅛	18 7/16	17½
102,100£	Do. 5 % Debs., repay. August, 1899	100	5 %	5 %	5 %	104 —107	104 —107	...	...
1,297,837£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	4 %	127 —130	127 —130	128½	127½
250,000	Eastern Extension, Australasia and China Teleg., Ltd. ...	10	7 %	7 %	7 %	17 — 17½	17 — 17½	17⅜	17⅛
54,100£	Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	5 %	5 %	5 %	100 —104	101 —105	103½	...
194,300£	Do. do. Bearer, 1,050—3,975 and 4,327—6,400	100	5 %	5 %	5 %	101 —104	102 —105	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	128 —131	128 —131	128	...
80,600£	Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5 %	5 %	101 —105	101 —105	103⅝	...
107,600£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	5 %	5 %	102 —105	102 —105	...	...
300,000£	Do. 4 % Mort. Debs. Nos. 1 to 3,000, red. 1909	100	4 %	4 %	4 %	106 —109	106 —109	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	108 —111 %	108 —111 %	111	...
180,227	Globe Telegraph and Trust, Ltd.	10	4⅜% §	4¼%	4¼%	10⅜— 11¼	10⅜— 11¼	10 15/16	10⅜
180,042	Do. do. 6 % Pref.	10	6 % §	6 %	6 %	17 — 17½	17 — 17½	17⅜	17
150,000	Great Northern Teleg. Company of Copenhagen	10	8⅜%	8⅜%	10 %	24 — 25	24 — 25	24¾	...
180,000£	Do. do. do. 5 % Debs.	100	5 %	5 %	5 %	104 —107	104 —107	...	...
17,000	Indo-European Teleg., Ltd.	25	10 %	10 %	10 %	53 — 55	53 — 56	55¾	54
100,000£	London Platino-Brazilian Teleg., Ltd. 6 % Debs.	100	6 %	6 %	6 %	109 —112	109 —112	...	...
28,000	Montevideo Telephone 6% Pref., Nos. 1 to 28,000... ...	5	4 %	4 %	4 %	2 — 2½	2 — 2½	...	...
484,597	National Teleph., Ltd., 1 to 484,597	5	5 % §	5 %	5½%	7 — 7⅛	7 — 7¼	7 1/16	6 15/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	17 — 19	17 — 19	17½	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	17 — 19	17 — 19	17½	...
119,234	Do. 5 % Non-cum. 3rd Pref., 1 to 119,234	5	5 %	5 %	5 %	6⅝— 6⅞	6⅝— 6⅞	6⅞	6 11/16
1,100,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	105 —108	105 —108	105½	104⅝
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	1	...	4½%	5 %	11/16— 13/16	11/16— 13/16	3/4	...
100,000£	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	100	4 %	4 %	4 %	108 —111	108 — 111	...	...
11,839	Reuter's Ltd.	8	0 %	*nil*	5 %	7 — 8	7 — 8	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	138 —143	138 —143	...	...
58,000	United River Plate Teleph., Ltd.	5	...	3 %	4 %	3 — 3⅛	3¼— 3⅜	3½	...
146,733£	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	102 —107	103 —108	...	...
15,609	West African Teleg., Ltd., 7,501 to 23,109	10	*nil*	*nil*	4 %	5 — 6	5 — 6	...	...
238,300£	Do. do. do. 5 % Debs.	100	5 %	5 %	5 %	103 —106	103 —106	...	...
30,000	West Coast of America Teleg., Ltd.	10	*nil*	*nil*	*nil*	½ — 1½	½ — 1½	...	...
159,000£	Do. do. do. 8 % Debs., repay. 1902	100	8 %	8 %	8 %	95 —101	96 —101	...	...
54,248	Western and Brazilian Teleg., Ltd.	15	2½%	3 %	3 %	7½— 8 xd	7½— 8	8	...
33,129	Do. do. do. 5 % Pref. Ord. ...	7½	5 %	5 %	5 %	6½— 6⅝xd	6½— 6¾	...	...
33,129	Do. do. do. Def. Ord.	7½	...	1 %	1 %	1½— 2	1½— 2	...	...
165,200£	Do. do. do. 5 % Debs. "A," 1880 Red.	100	6 %	6 %	6 %	103 —107	104 —108	106	...
206,400£	Do. do. do. do "B," do.	100	6 %	6 %	6 %	103 —107	104 —108	...	...
88,321	West India and Panama Teleg., Ltd.	10	⅛%	¼%	⅛%	1½— 1½xd	1½— 1½	1 5/16	1½
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	11½— 12 xd	11½— 12	11⅝	...
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	9½— 10½xd	9½— 10½	...	...
80,000£	Do. do. 5 % Debs. No. 1 to 1,800 ...	100	5 %	5 %	5 %	108 —111	108 —111	...	...
1,777,000$	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds ...	$1000	7 %	7 %	7 %	107 —112	107 —112	...	...
164,300£	Do. do. 6 % Ster. Bonds.	100	6 %	6 %	6 %	100 —105	100 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electy. Supply	5	4½%	4½%	5 %	9½— 10	9½— 10	9 7/16	9¼
10,277	*Chelsea Electricity Supply, Ltd., Ord., Nos. 1 to 10,277 ...	5	5 %	5 %	5 %	8 — 8½	8 — 8½	8 7/16	...
60,000	Do. do. do. 4½ % Deb. Stock Red. ...	Stock	...	...	4½%	114 —117	114 —117	...	...
40,000	City of London Elec. Lightg. Co., Ltd., Ord. 40,001—80,000	10	...	5 %	5 %	15½ — 16½	15½ — 16½	16½	16
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	16 — 17	16 — 17	17	...
300,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	128 —133	128 —133	130	...
22,475	County of Lond. & Brush Prov. E. Ltg. Ltd., Ord. 1—22,475	10	...	...	*nil*	8 — 9	8 — 9	...	...
20,000	Do. do. do. 6% Pref., 40,001—50,000 ...	10	...	...	6 %	13⅜— 14¼	13⅜— 14¼	14⅛	...
10,000	Do. do. do. iss. at 2 pm., all paid	10	...	...	...	7½— 8½	7½— 8½	...	...
49,900	*Metropolitan Electric Supply, Ltd., 101 to 50,000 ...	10	2½%	3 %	4 %	13 — 14	13 — 14	13½	...
12,500	Do. Ord., 50,001—62,500, iss. at £2 prem., £1 paid	10	...	...	...	6½— 7	6½— 7	...	...
150,000£	Do. 4½% first mortgage debenture stock	...	4½%	4½%	4½%	121 —124	121 —124	...	...
6,452	Notting Hill Electric Lightg. Co., Ltd.	10	...	1 %	2 %	9½— 10½	10 — 11	10⅜	...
19,980	*St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-20,080	5	4½%	6½%	7½%	12 — 13	12 — 13	12⅝	12½
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	10 — 11	9½— 10½	10	9¾
50,000	Do. do. 4 % Deb. stock Red. ...	Stock	...	...	...	106 —109	106 —109	...	...
67,900	*Westminster Electric Supply Corp., Ord., 101 to 60,000 ...	5	4 %	5 %	7 %	10½— 11½	11 — 12	11 7/16	10⅞

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

‡ Unless therwise stated all shares are fully paid. ‖ Dividends paid in deferred share warran profits being used capital.

§ Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME.	Stock or Share ‡	Dividends for the last three years. 1893.	1894.	1895.	Closing Quotation, Dec. 2nd.	Closing Quotation Dec. 9th.	Business done during week ended Dec. 9th, 1896. Highest.	Lowest
90,000	Brush Elecl. Enging. Co., Ord., 1 to 90,000...	8	5 % §	2½%	...	⅞ — 1⅛	⅞ — 1⅛	1 5/16	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	6 % §	3 %	...	1 — 1¼	1 — 1¼	1¼	1⅛
125,000£	Do. do. 4½ % Perp. Deb. Stock.... ...	Stock	4½%	4½%	...	110 —113	110 —113	...	...
76,770	Do. do. 4½% 2nd Deb. Stock Red. ...	Stock	...	...	...	96 — 100	96 —100	...	...
9,104	Central London Railway, Ord. Shares	10	...	...	...	9⅜— 10¼	9⅜— 10¼	10¼	...
207,649	Do. do. do. £4 paid	10	...	...	...	3⅞— 4⅛	3⅞— 4⅛	4	...
630,000£	City and South London Railway	Stock	1½%	1½%	1 5/16%	53 — 55	53 — 55	54⅝	54½
28,180	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180	5	3 % §	*nil*	*nil*	1⅜ - 2¼	1⅜ - 2¼	...	...
89,261	Edison & Swan United Elec. Lgt., Ltd., "A" shrs, £3 pd. 1 to 89,261	5	7 %	5 %	5 %	1⅝— 2¼	1⅝— 2¼	...	...
17,139¶	Do. do. do. "A" Shares 01—017,139	5	7 %	5 %	5 %	3 — 4	3 — 4	...	...
100,000	Do. do. do. 4½% Deb. Stock Red. ...	Stock	...	4½%	4½%	103 —106	103 —106	...	...
110,000	Electric Construction, Ltd., 1 to 110,000	2	*nil*	*nil*	5 %	1⅜ - 1⅝	1⅜— 1⅝	1 9/16	...
12,845	Do. do. 7 % Cum. Pref., 1 to 12,845 ...	2	7 %	7 %	7 %	2½ - 3	2½— 3	2 1/16	2⅜
91,195	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000	2	*nil*	*nil*	...	⅛— ⅜	⅛— ⅜	...	...
69,385	Elmore's Wire Mfg., Ltd., 1 to 69,385, issued at 1 pm. ...	2	*nil*	*nil*	...	¼— ½	¼— ½	...	...
9,600£	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ...	10	*nil*	*nil*	10½%	10½— 11½	10½— 11½	...	...
10,000	Henley's (W. T.) Telegraph Works, Ltd., Ord.	10	5 %	6 %	8 %	17½ - 18½	17½ - 18½	...	...
3,000	Do. do. do. 7% Pref.	10	7 %	7 %	7 %	18½ - 19½	18½ - 19½	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock	Stock	...	...	4½%	109 —114	109 —114	113	...
50,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	10	12½%	10 %	10 %	20½ - 21½	20¼ - 21½	21¼	20⅜
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	105 —108	105 —108	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	1 %	1½%	2⅜%	13⅜ - 14	14¼ - 14½	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	16⅞— 17⅜	17 — 17½	...	...
37,350	Telegraph Constn. and Maintce., Ltd.	12	20 %	20 %	15 %	39 — 42	39 — 42	40½	39
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	5 %	104 —107	104 —107	..	...
54,000£	Waterloo and City Railway, Nos. 1 to 54,000, £6 paid ...	10	...	...	...	7⅜— 8¼	7⅜— 8¼	8 1/16	...

Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last dividend paid was 50% for 1890.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.
CROMPTON & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—0%; 1891—7%; 1890—8%.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

* Birmingham Electric Supply Company, Ordinary of £5 (£4 paid), 7⅞, £5 (fully paid) 9⅛.
Electric Construction Corporation, 6 % Debentures, 104—106.
House-to-House Company (£5 paid), 4½—5.
Do. do. 7 % Preference, of £5, 8½—9.
Do. do. 4½% Debentures of £100 109—111.
Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid) 10—10½; 1st Preference Cumulative 6 %, £5 (fully paid), 8¼—8⅜.
London Electric Supply Corporation, £5 Ordinary, 1—1¼.
Yorkshire House-to-House Electricity Company, £5 Ordinary Shares fully paid, 7⅞—8.

* From Birmingham Share List.

Bank rate of discount, 4 per cent. (October 22nd, 1896).

REVIEWS.

Galvanism in the Treatment of Neuritis, &c. By CAREY COOMBS, M.D. Bristol: John Wright & Co.

Electricity in Electro-Therapeutics. By EDWIN J. HOUSTON, Ph.D., and A. E. KENNELLY, Sc.D. New York: The W. J. Johnston Company.

There can be no doubt that the application of electricity to medicine has in recent years made considerable progress, and there is every indication that this branch of the healing art has a considerable future before it. One great drawback to progress in electro-therapeutics is the very general want of a thorough knowledge of electrical laws exhibited by medical men who take up this subject. Dr. Coombs's little book, though containing much valuable information, is not, unfortunately, free from dreadful examples of this weakness. For example, he says, "Galvanic currents may also be taken from the public supply by means of a transformer which interposes large resistance between the main and the patient, the two or more amperes supplied for lighting can be converted into a current of a few milliamperes and of increased voltage." Surely such a statement as this is very confusing and misleading; for most electro-medical purposes the voltage is transformed down and not up, and the current in the secondary circuit depends on the resistance among other things. Again at p. 24 Faradism is said to change its direction at each interruption. If by Faradism is meant the currents produced by an induction coil, the direction of current is certainly the same at each interruption. It is a pity that medical men should continue to use such antiquated terms as galvanism and Faradism, instead of the more exact terms now used by electricians. Still another example of inaccurate expression will be found at p. 38, where we find, "As the resistance of the tissues is much less than when both electrodes are on the skin, *a weak current* should be used." Evidently the author here means a low E.M.F. should be employed. Dr. Coombs has a distinct preference for the continuous current in the treatment of neuritis. This he obtains from a battery of 60 small Leclanché cells, fitted with a switch for throwing any number of the cells into circuit, and a galvanometer for measuring milliamperes. Such a battery as this in Dr. Coombs's possession has required renewal only twice in 20 years. The work contains descriptions of electrical apparatus, and cites a number of cases in which electrical treatment has been successfully applied.

The work of Drs. Houston and Kennelly is more ambitious, and is intended to supply the electro-medical practitioner with the necessary amount of exact knowledge of electricity and electrical apparatus. Such a work ought to be as clear and simple in its exposition as is possible without the sacrifice of accuracy. On the whole this has been well accomplished. Chapters are devoted to the electromotive force, resistance and current; then the various kinds of E.M.F., influence machines, induction coils, and other electrical apparatus used for medical purposes, are obtained. But to whom much is given, from him much shall be required. The authors write from the standpoint of physicists and electricians for the instruction of medical men on a subject which has hitherto been somewhat foreign to their science. Under these circumstances we consider it is loose and reprehensible to define *electromotive force* as (p. 25) "the force which tends to set electricity in motion, so as to cause an electric flow. It is essential to bear in mind that in no case can electricity be produced by any machine without the prior production of electromotive force, just as no motion can exist in a material object without the antecedent application of a material force, *i.e.*, of a body-moving force." Now E.M.F. and "body-moving force" are magnitudes of entirely different dimensions and resemble each other only in name. E.M.F. in the strict sense of the word is no force at all, but is analogous to difference of level in the gravitation field. Such inaccuracies ought not to exist in a text book professing to expound first principles.

America, whether justly or not, is credited with many

solecisms in our technical terminology. The beauty of such creations as "cablegram" consists, as with American drinks, in the mixture of highly heterogeneous elements. But perhaps the classicist never received so great a shock as he will on reading the following (p. 68): "In the case of many liquids, the resistivity is conveniently expressed in ohms, but in the case of materials which possess very poor conductive power, generally called insulators, the resistivity becomes enormously great and is more conveniently expressed in megohms, in *begohms* or billions of ohms, *i.e.*, thousands of millions, or in *tregohms*, or trillions of ohms, *i.e.* millions of millions." Such words as begohms and tregohms, we hope, have no chance of being admitted into any self-respecting vocabulary.

The diagram of the discharge of an electrostatic machine at p. 143 is distinctly misleading. The successive discharges are represented as following close, one behind another, while, as a matter of fact, the time of discharge would relatively be represented by seconds, and the intervals between by years. The frictional machine is stated to be more sensitive to moisture than the influence machine, but this is by no means a general experience. The true superiority of the influence machine is that it supplies a much greater quantity of electricity with less expenditure of energy.

This volume, however, gives much useful information about electro-medical apparatus and the theory of their action, and we can honestly recommend its perusal to medical men engaged in electro-therapeutics. It is very well up to date, and we think it would be difficult to find at the present time a more complete work covering the same field.

Universal Bimetallism. By Richard P. Rothwell. New York and London: The Scientific Publishing Company.

This is an appeal for bimetallism and a sort of national clearing house.

Of the first we cannot say much, but of the second a good deal may be said, for it is possible that given such a system the shipment of money to and fro, and its waste and loss in transit, would be much reduced. The action of a clearing house is already, to a considerable extent, secured under present arrangements of banking, and we do not pretend to say that the actual stoppage of all gold movement can be prevented, though with good faith all round there should be no need for a metallic currency at all. Paper ought to be capable of representing a store of gold, and given a mass of gold at the clearing house the allotment of this to any country could be easily effected by the creation and destruction of so much paper. The theory is beautiful and works perfectly so long as the holders of the paper are convinced that the metal is there which the paper represents. Our author may be all right on the mere principle of the clearing house, but he makes it one of its functions to institute universal bimetallism, to secure a fixed ratio from time to time of gold and silver, and to arrange what every country must pay in gold for a certain amount of silver money to place all on an equal basis. He thinks by so doing, that he will have given to silver in men's minds a stable value. What power on earth can fix the value ratio of two articles. No American ever writes on finance without having a fling at England, her commercial selfishness, and so on. It forms the keynote of all American diatribes against us. Why is this? Americans have builded a ring fence of nearly insurmountable tariffs round their country. England has no such fence, and asks all the world to come and sell freely. The ring fence constitutes a sign of American genius. Our trade freedom, which we do not claim as a monopoly, and which any nation can adopt for itself, is what constitutes our commercial selfishness. Nothing will satisfy American ill-will in respect of this country, though to keep us out of the Great West the Eastern States have raised the ring fence and ruined the Western farmers. Having ruined their own Westerners, they point to England as the cause, and we get the revilings of both East and West.

Mr. Rothwell figuratively goes for England whose fault it is that silver has less value than formerly, and whose duty it is to pay away so much gold in order that silver may be remonetised. Bimetallic enthusiasts cannot see the similitude between great and small finance. If Mr. Rothwell were to send out into Broadway for a new hat and received instead a pair of boots of equal retail price because the dual store keeper had made a cheap purchase of boots, we fancy Mr. Rothwell would look annoyed. Yet this is at the bottom of all bimetallism. If silver were really capable of being used for payments the only system of doing so would be to issue silver warrants in the way that iron warrants are issued for pig. Silver would soon approximate to its true relative value and such warrants might become to some extent passable as a sort of money. Not being like pig iron so liable to be absorbed in manufactures at every trade revival the speculation in iron warrants would perhaps not extend to silver, and to the extent of its true value silver might aid the money system. But we fail to see how the two metals can be run in parallel. England has been a gold standard country for nearly a century, yet the silver ratio has been nearly constant for 200 years up to the time when Germany became a gold standard country. If Americans would only look at matters fairly and wipe out their bias against England they would see that the depreciation of silver dates from Germany's action in 1873. We do not say Germany's action was a cause. It may have been an effect only. As a matter of fact while the production of gold has kept a fairly steady annual rate for 40 years until quite recently, that of silver has gone up three-fold. America herself has been the chief producer of silver and now asks the world to pay for the surplus at the old ratio. If the old ratio is to be maintained why do not Americans limit production? The silver production of America is so small a part of the total production of all sorts of goods that all this silver outcry strikes one as a bit curious. Any stick is good enough to beat a dog with, and this question of silver values seems to be a handy stick to whack the British Lion.

The tactics of Mr. Rothwell have been condemned at the polls by the sense of the mass of Americans. Wheat has gone up in price, silver has again gone down. This wretched England of ours is buying wheat from America and saving her farmers from bankruptcy, yet the author and his co-thinkers would have us sunk beneath the sea simply because America is suffering from the results of her selfish tariff policy instituted solely to spite England.

The Manufacture and Properties of Structural Steel. By Harry Huse Campbell, S.B. Second Edition. The Scientific Publishing Company, New York and London. 1896.

It is a relief to turn from an American book on bimetallism to the present volume. However incapable Americans may be in dealing with economic questions, so that their outpourings make them a laughing stock to the world, the very opposite must be said of their genuine technical literature. We rarely pick up an American technical work, be it on bridges, the steam engine, or other subject, without a desire to stick to the book. This is one of the kind. Its title tells what it is, and it is what its title professes, for it is a very full and excellent treatise on steel, its manufacture and treatment, the influence of the many impurities to which steel is subject, and contains a mass of statistics of tests. We confess to have read few books which are more clear in their description and arguments. The author, who writes from Steelton, Pa., has every opportunity in the works there of the Pennsylvania Steel Company of making tests and observing the effects upon the physical properties of steel of the various impurities or ingredients which enter into the composition of this most important alloy. We think he shows very clearly the weight to be attached to each element. Sulphur, the cause of red shortness, is dismissed with little comment. Its influence is objectionable in the manufacturing stage, but not upon the finished article, except where it is apt to cause a coarse crystallisation as in eye bars. Phosphorus, however, is properly condemned. The author does not hesitate to use the word criminal in regard to the use for structural purposes of a metal containing so much as 0·12 per cent. of phosphorus.

Mere physical tests will not detect this mischievous and dangerous element in steel. The engineer must demand a chemical analysis. As to the proportion of phosphorus to be allowed, there is no real limit. The less the better. Safety

increases as phosphorus decreases. As to copper, this is held to be a neutral. It has never been found necessary to invoke copper to explain a failure, and steel may contain 1 per cent. of copper without serious effects, but if sulphur is present to the extent of ·08 or ·10 per cent., the effect is bad at high temperatures. This, however, in no way affects the engineer or user of the metal. All these effects are fully considered and the influence of work upon rolled metal, the comparison of Bessemer and open hearth steel, gaseous fuel, temperatures, linings and the multiplicity of technical details involved in the making of reliable steel are all fully dealt with. Speaking of the composition of the slags in the open hearth process, the author refers to the force at work in an acid furnace which keeps the slag at a practically constant composition, the percentage of silica being 50 per cent. and of manganese and iron oxides, 45 per cent. There is an automatic adjustment to a fixed status that is one of the most wonderful phenomena of chemical physics. This is attributed by the author to a tendency in all forces to work along lines of least resistance, which in this case means that the slag will seek combinations which tend to greater fluidity. Similar actions proceed in basic slags and are similarly explained. In this respect, the law of mass action as initiated by the French chemist, Berthellot, seems to find a hearing. Nernst in his work on "Theoretical Chemistry," says that the kernel of Berthellot's idea is to-day the guiding principle of the doctrine of affinity, and we think if the able author of the book before us would consider the reactions of the hearth in the light of the most advanced chemical theories, he would be able to shed a flood of explanation on them and show how the loss of iron is to be minimised while perceiving that there is perhaps a minumum loss, below which it is not possible to go. Just as the laws of thermo-dynamics have demonstrated the impossibility of attaining an efficiency in the heat engine once dreamed to be possible, so do the laws of chemistry show how, in the recovery of metals from their ores, there is a point beyond which recovery cannot proceed. Efficiences of cent. per cent. occur only with scientific experts. The book is one that should have a large sale, and it is got up and bound in the customary excellent style of American publications.

Inventions and their Commercial Development. By John Samson, C.E. London: Simpkin, Marshall, Hamilton, Kent & Company, Limited, 4, Stationers' Hall Court.

The first portion of this book is taken up with a dissertation on inventive facilities and the application of the same. A great deal of space is taken up with "advice" to inventors, which advice is very largely a recommendation to do what must be perfectly self-evident to the person advised, but a number of pages of matter of this character forms convenient padding. However, there is plenty of information given which is of considerable value and may be noted with advantage by inventors. The writer hardly dwells sufficiently upon the fact of the enormous waste of money which takes place annually from the number of useless inventions brought out, though he quite correctly says "patenting may be regarded as a lottery. The majority draw blanks and lose their stakes, that is, the fees they pay for their patents." Considerable stress is laid upon the methods and artifices of company promoters, and it is shown how it is that so many of these enterprises fail to succeed. Finally, the author propounds a scheme by which he would put the development of matters inventive on a proper footing, so that they can be properly financed and developed. The scheme is a somewhat elaborate one, but probably contains something that is sound in it, though there may be some doubt whether it would work as smoothly as the author anticipates.

The "Practical Engineer" Pocket-Book, 1897. Manchester: The Technical Publishing Company, Limited.

The eighth annual issue of this handy pocket-book shows still further improvements on previous issues. A section of notes and data on mine engineering and machinery has been added, and the section relating to electricity has been enlarged by the addition of notes on electric traction and electric welding, this matter would, however, be more suitable for a pocket-book if it consisted less of brief general descriptions of systems and more of figured data.

THE GREAT CYANIDE CASE IN THE TRANSVAAL.

The Johannesburg *Standard and Diggers News* of November 5th, 1896, contained the following report of the judgment in the great cyanide case in the Transvaal. Our contemporary is very jubilant over the result of the litigation, as is shown by such sub-headings as:—"The Industry Victorious." "The McArthur-Forrest Patents." "Cancelled by the Court." "Away with Royalties." "Jubilation in Town." "Another Disability Removed."

The Judgment.

Pretoria, 4th (Special).—The Chief Justice said that "this was a case against the defendant company to have two patents, Nos. 47 and 74, cancelled on the ground that the said patents contained nothing new, and that it was well known to the general public some time before the patent was obtained that cyanide of potassium could be effectively used in the treatment of quartz, and, further, that the patent was not of a sufficiently specific nature.

The question for the court to decide was, was the process an invention or not? The patents were for the treating of quartz by cyanide of potassium. The court had very good and able evidence given in several cases by experts. The court was considerably assisted by the evidence of Dr. Hahn and others. Prof. Raymond, an American expert, stated that the treatment of quartz by the cyanide process was public property long before the dates when the patents were granted, and that the fact of the solution being made weaker did not constitute a new discovery, as it was only following the natural order of economy in utilising expensive ingredients at the least possible cost. Mr. Caldecott, who possessed a practical knowledge of the treatment of the quartz, said that the strength of the solution should depend on the quality of the quartz. Mr. Newberry, an Australian expert, held the same views. Mr. van Gander said that his solution was one-half of the strength as specified by the McArthur-Forrest process. Dr. Lœvy said, on the other hand, that a stronger solution of cyanide of potassium had a better effect on quartz.

All the evidence went to prove that the use of cyanide of potassium in the treament of gold quartz was a well-known fact prior to the date when the patent was granted.

In 1884 one Simpson took out a patent in the United States for the treatment of quartz by means of cyanide of potassium and carbonate of ammonia. In the Court of Appeal in England, the judges of appeal held that the Simpson patent was not an anticipation of the McArthur-Forrest. That court also held that there was an invention in the McArthur-Forrest treatment. This judgment of the Court of Appeal was contrary to the judgment given by Judge Romer, whose decision was supported by a decision given by the *German Court of Appeal*. With all due respect, to agree with the judgment given by Judge Romer and the German Court of Appeal, which held that the McArthur-Forrest process was anticipated by the patent of Simpson.

The question for the court was whether the treament of quartz by the McArthur-Forrest process was something new; and could the treatment be patented. He did not think so, for the use of cyanide of potassium in the treatment of quartz was a well known fact previous to the date on which the patent was taken out. Van Gander claimed that he used for some time previously a weaker solution of cyanide than the McArthur-Forrest process. This fact would, however, give no right to Van Gander to patent his treatment. The fact of his using a weaker solution of cyanide of potassium was not an invention which could be patented.

The very most which could be said in favour of the McArthur-Forrest process was that it extended the Simpson process. All that the McArthur-Forrest people had done *was to give to the world the words* "selective action." There was no novelty; there was nothing new in the Forrest treatment. The fact that the process had been successful on the Witwatersrand was not enough. It must be proved that the McArthur was the first or the original invention.

After a careful perusal of all the evidence, he had come to the conclusion that judgment must be given for the plaintiff with costs, and *that the two patents be cancelled.*

Mr. Justice Morice, in a lengthy judgment, dissented, and was in favour of leave being given to the defendant company to amend their specification.

As it was too late, Mr. Jorissen's judgment was not read, but the Chief Justice said that Judge Jorissen agreed with him.

Judge Jorissen's View.

Pretoria, 4th (Reuter).—Justice Jorissen was of opinion that Patent 74 should be cancelled; but, with regard to Patent 47, that leave should be given to defendants to amend their patent in the terms of their application to the court.

PROCEEDINGS OF SOCIETIES.

The Northern Society of Electrical Engineers.

On the Manufacture of Alkali and Bleach by Chemical and Electrolytical Methods. Paper read by Bertram Blount, F.I.C., F.C.S., Assoc.Inst.C.E., December 7th, 1896.

There is an unceasing demand, and one, moreover, which is not likely to determine, or even abate, as long as our present concept of civilisation endures, for those products obtainable from salt as a raw material, which we include by means of the terms alkali and bleach, Viewing the stupendous quantities of all forms of alkali, soda ash,

caustic soda, soda crystals, and bi-carbonate of soda, and of bleach as powder, or in solution as bleaching liquor, which are prepared for the market, it is not easy to understand in what way, and in what directions, absorptions of these products can occur. It would doubtless be interesting to trace a few typical hundredweight of each material from the works to its far-away goal—the common sewer—but the inquiry is not sufficiently within our present scope to merit close prosecution, and is too complex and ramified to be dismissed in a paragraph. It is sufficient to realise that the demand exists and is likely to continue.

But although there is a steady, and, as far as conceivable, a permanent demand, yet it is not voracious or indiscriminate. Goods to sell must either be good or cheap—perfectly both good and cheap.

Neither will the market take any account of the ingenuity of contrivance which has led to the production of a given commodity. It is concerned solely with the nature and quality of the commodity, and with its price.

It follows that a process to be successful in the commercial sense of being remunerative, must be capable of preparing either a better product at the same rate, or the same product at a cheaper rate, before it can hope to be shown any preference over older and better established processes. It matters not a halfpenny to the consumer what elegant principles are illustrated by the process used to supply him with the material which he requires; he looks only to the stuff and its price—very often, indeed, only to the price; if his regard wanders further afield, it is more likely to light upon the drum in which the material is packed than upon the scientific subtleties whereby the drum has been filled.

I have not said this in praise or condemnation of the consumer; the discussion of ethical questions is altogether foreign to my purpose. I am merely concerned to inculcate this one fact—obvious, indeed, but constantly forgotten—viz., that no beauty of principle or execution can save a process which does not pay, and that no faultiness of design or performance can expunge one which does. This clearing of the ground is particularly necessary when considering the present situation of the trade in alkali and bleach and the tendencies, latent or patent, which may eventually or will actually shift its centre of gravity from the chemical to the electrical side. On the face of it, the extant chemical methods of manufacture are roundabout and clumsy, while the processes dependent on the use of electrical energy are singularly simple and direct. As long as zinc was the sole available fuel for the production of electrical energy, chemical methods for obtaining any material, the conjoint reactions for the synthesis of which were endothemic, held the field without possibility of rivalry. With the advent of an efficient dynamo the conditions of competition were radically changed. In spite of the large loss, computed by the ingenious at 90 per cent. or more, which the energy of coal undergoes before it can be delivered as current at the terminals of an electrolytic cell, the cost of a given quantity of electrical energy is no longer so great as to make electrical methods unthinkable, when compared with the direct (but wasteful) application of energy as heat by the combustion of fuel in processes that are definitely chemical. It must be remembered that elaborate determinations—thanks chiefly to the zeal of engineers intent on improving prime movers—of the total loss from boiler furnace to crank-shaft have been repeatedly made, and that every layman of intelligence is aware of the wastefulness of these intermediaries; whereas, on the other hand, the quantity or heat going up the chimney in the simplest furnace operation has either not been computed, or if computed, is not a matter of common knowledge. Thus, in the distillation of zinc, the energy required to be supplied from the furnace for the reduction of ZnO to Zn (in gram equivalents) is 56 cal.; but the actual quantity needed is at least 5,200 cal., involving the consumption of 10 lbs. of coal per pound of zinc, or more than 90 times the calculated minimum quantity. It may therefore be feasible to adopt a process, admittedly using energy in a costly form in preference to one capable of being performed by energy in a cheap form such as direct heat, if the former be directed with such nicety that the energy is less wastefully employed. A comparison of the energy required for the conversion of common salt into the products, NaOH and Cl, by the Leblanc process, and by any one of the moderately efficient electrolytic processes now seeking a footing may prove instructive. In making this comparison I have avoided stating the quantities of heat theoretically necessary for the several reactions, as these quantities bear but a remote relation to those which are actually required. Thus in the preparation of salt-cake (the first step in the Leblanc process) although the reaction represented by the equation,

$$2\,NaCl + H_2SO_4 = Na_2SO_4 + 2\,HCl$$

needs but a small access of heat for its completion, yet in practice it requires a considerable consumption of coal to bring it about. It will, therefore, be of greater utility to take as a basis of comparison the fuel found by the actual needs of manufacture to be required for each stage under consideration. In making salt-cake by the action of sulphuric acid on salt, about ·3—·5 ton of coal is needed for the production of 1 ton of salt-cake. The surplus heat from the combustion of this fuel either escapes with the flue gases, or is carried off by the vapour of hydrochloric acid, which has to be cooled, condensed and collected by absorption in water, its energy existing as sensible and latent heat being communicated to the condensing and cooling water. In the next stage, the black ash process, the consumption of fuel is ·7 to 1·0 per ton of salt-cake, reckoning in both that used for heating the furnace and that for mixing with the charge.

Of this quantity about ·3 ton is needed theoretically to bring about the reaction,

$$Na_2SO_4 + 4\,C = 4\,CO + Na_2S,$$

and in practice about ·4 to ·5 ton is used, leaving a balance of ·3 to ·5 ton consumed in the furnace to produce sensible heat and to cause the reaction to take place.

This liberal expenditure is less lavish than it seems, because the waste of the black as furnaces is used to boil down the tank liquor (obtained by the lixiviation of the black ash). Nevertheless the expenditure is large, and in the end leaves the soda ash rather worse off, from an energy point of view, than it was at the beginning, inasmuch as the "black salt" (the product of lixiviation), contains a molecule of water which has to be driven off by calcination, involving the consumption of about ·4 ton of coal per ton of soda ash, *i.e.*, about ·3 ton per ton of salt-cake originally charged. We are now in a position to sum up roughly the quantity of fuel required to produce 1 ton of soda ash by the Leblanc process, carried out with neither unusual waste nor special economy.

Consumption of Coal per ton of Salt-Cake.

	Ton.
In salt-cake furnace	0·4
In black ash furnace	0·8
In finishing furnace	0·3
	1·5
i.e., per ton of soda ash	2·0 tons.

Seeing that there is always a sensible loss of soda (15—20 per cent.) in the process of passing from Na_2SO_4 to Na_2CO_3, this consumption of coal is rather an under-statement than the reverse.

In preparing caustic soda from the soda ash made in this manner, a further quantity of fuel will be requisite, both for burning the lime needed as a causticing agent and for boiling down the caustic liquor. As surplus heat from the black ash furnaces is used for a part of the causticising process, the quantity of additional fuel is difficult to compute, but if the total amount (including that needed for burning the lime) be put down at ·2 ton per ton of caustic soda produced the estimate will not be excessive. This corresponds with about ·1 ton of coal reckoned on the original salt-cake, and the total consumption of fuel for the production of 1 ton of 77 per cent. caustic may be set down with an approximation sufficient for our present purpose at 2·8 tons.

A corresponding estimate of the cost of fuel needed to produce 1 ton of sodium carbonate or 1 ton of caustic soda by any modern electrolytic process may be usefully made.

Assuming that 1 H.P. hour can be obtained by the consumption of 2 lbs. of coal using modern boilers and engines of good design, and that four-fifths of the energy developed in the engine is available at the terminals of an electrolytic cell, and, further, taking the average working voltage of the cell at 4 volts, it appears that the consumption of coal necessary for the production of 1 ton of caustic soda, including that necessary for concentrating the alkaline lye obtained as the immediate product of electrolysis, is 4·2 tons, and that needed for the production of 1 ton of sodium carbonate may be stated at 3·3 tons, quantities greater certainly than those needed for the Leblanc process, but of the same order of magnitude. But by the electrolytic process, as usually conducted, an amount of chlorine approximately equivalent to that of the caustic soda produced, is evolved at the anode.

The energy expended in the production of caustic soda also suffices for the generation of chlorine, and no further quantity of fuel has to be debited against the process. But in obtaining chlorine by the Leblanc process, a certain further expenditure of fuel is inevitable. The chlorine appears in the form of hydrochloric acid, and is usually worked up by the Weldon process. In this, which involves heating the chlorine stills, heating the purified still liquor mixed with lime, and blowing in large volumes of air to reoxidise the manganous oxide (all processes needing fuel) a considerable consumption of coal occurs. Similarly in the Deacon process, which uses the hydrochloric acid as gas without condensation in water, heating the air needed to oxidise the gaseous hydrochloric acid is requisite, and in all about 1 ton of coal is needed for 1 ton of bleach produced, or, in round numbers, 3 tons of coal per ton of chlorine, or 2·6 tons of coal per ton of caustic soda. Thus the total consumption of fuel for the production of 1 ton of caustic soda and its equivalent amount of chlorine rises to 5·4 tons; similarly, for 1 ton of sodium carbonate and its equivalent of chlorine, about 4 tons of fuel will be required. These figures are to be compared with the corresponding values 4·2 and 3·3 tons for the same products prepared electrolytically.

In the above comparison no pretension to exactitude is made, inasmuch as accurate data are not readily accessible, and the consumption of fuel will vary largely according to the practice of each works and the degree of efficiency of the plant and staff; but enough has been said to make it clear that the consumption of fuel by the two methods is not dissimilar, and that on the present basis for the production of electrical energy no great advantage accruing from the saving of coal is to be credited to the electrolytic process. But although it is a comparatively simple matter to arrive at a decision as to the consumption of energy by each of the two typical processes, it must not be supposed that decision between them can be based on this computation alone. In all inquiries of the kind it is necessary to preserve the most rigid distinction between the cost of a given operation in energy and in money. These are incommensurable quantities for the adequate reason that the energy cost of a given product is the inevitable outcome of physical facts, while the money cost of a given product is purely no expression of its particular power of appeal to some need, psychical or physical, of human beings.

Whence it is clear that a 50 carat diamond, which is energetically inconsiderable when matched with a ton of anthracite, is pecuniarly to be preferred thereto, because it appeals successfully to certain instincts indigenous in barbarous humanity.

If then we dismiss electrolytic processes, as at present carried out, as being to no great extent superior to existing chemical methods in their consumption of energy for a given output, on what ground, if any, are they to be preferred? The first is that no form of matter,

other than sodium chloride and water, is necessary for the production of caustic soda and chlorine from brine, and that there is consequently no waste product.

In the Leblanc process, on the other hand, sulphur and nitrate of soda (for the production of sulphuric acid) are needed in the very first stage, viz., the manufacture of salt cake. Of these the sulphur may be recovered by the Chance process, and the soda of the nitrate of soda may find its way into the salt-cake furnace, but the nitric acid is ultimately lost. Again, in the black ash process, the lime present after the completion of the process as calcium sulphide, finally appears as a sludge of impure calcium carbonate in the waste from the Chance process. Attempts to utilise it as cement have been made; but as far as I am aware, with very dubious success. In like manner the lime from the causticising of the soda ash is obtained as carbonate, and is substantially a waste product.

Similarly with regard to the working up of the hydrochloric acid for chlorine, one finds iron and similar impurities from the still liquors in the Weldon process, and calcium chloride after re-oxidation and the production of Weldon mud, to be disposed of as valueless materials. It must be remembered that these waste products not only mean cost in themselves, but also necessitate an expenditure, which is sometimes serious, in handling and removing them. In the electrolytic process, on the other hand, nothing but finished products should need to be conveyed from the works. The only bye-product (hydrogen, appearing at the cathode together with caustic soda) can be trusted to effect its own removal if allowed access to the air.

The other respect in which an electrolytic process has an advantage over chemical methods of making alkali is in the saving of labour. This is to some extent an outcome of the freedom from the necessity for removing waste products spoken of above. Moreover, the material is handled in a liquid or gaseous form throughout the process, up to the point at which the caustic soda solution is boiled down for the production of solid caustic. There is nothing corresponding with the loading in of salt to the salt-cake furnace and the removal of the salt-cake therefrom; nor of the similar proceedings necessary at the black ash stage. In these days when the manual worker is apt to be exigent, any process which tends towards his deletion has a commercial advantage over those of its competitors which depend upon his aid. It is not merely a diminution of running expenses which may be secured; it is the freedom from the fear of a disastrous stoppage of the whole works which makes labour-saving methods and appliances attractive to the manufacturer.

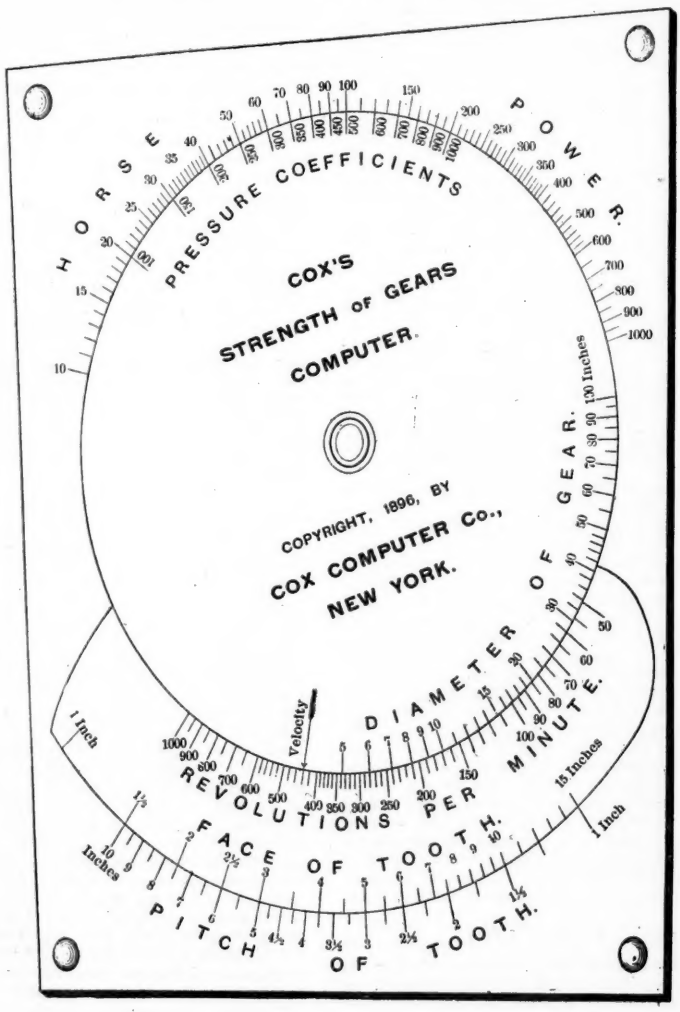
On the contrary side must be set the comparatively high cost of an electrolytic installation and its high rate of depreciation. Seeing that it is impracticable to use more than a very moderate current density at the electrodes of a cell in which a solution of salt is being decomposed, it is requisite to have a large number of cells for even a moderate output; thus the cost of the plant per ton of material produced per day is high. Further, the permanence of such forms of decomposing cell as have been devised hitherto, is not very great. Diaphragms and anodes suffer electrolysis as well as does the intended electrolyte. A porous septum which shall have a reasonably low resistance, and shall nevertheless keep the products of electrolysis fairly well apart is difficult to design, and complete success has not yet attended the efforts of inventors in this direction. A good word may be said for the use of mercury as an intermediate electrode and carrier of the products of electrolysis, in that it removes the need for a porous septum, and appears in practice, as in theory, to undergo no sensible loss or depreciation. Again, the anode is a standing obstacle. In almost all cases carbon is used, the particular form of that substance known as retort carbon being preferred. But even this very dense and refractory form of carbon is not wholly unaffected, and anodes made therefrom can only be considered as semi-permanent portions of the plant. There are, it is to be feared, no reliable data as to the life, when in constant work, of an electrolytic cell for the production of alkali and bleach. One must be content with qualitative statements. Nevertheless, it is well to recognise that it is not sufficient in computing the cost of an electrolytic process to reckon a capital expenditure, and to calculate on that the usual charges for interest and depreciation; a portion of the plant, viz., the diaphragms and anodes, should have a specially high rate of depreciation charged upon them, if, indeed, they might not rather be reckoned as part of the current expenditure, just as so much oil and waste would be.

(To be continued.)

SOME SPECIAL FORMS OF COMPUTERS.*

By F. A. HALSEY, New York City (Member of the Society.)

In these days of specialisation most engineers have numerical problems which require to be solved in the same or similar forms over and over again. These may or may not involve difficulties and complexities, but in any case the routine soon becomes drudgery. It seems to me that I am performing a real service in calling attention to a type of computer by which such problems are solved in a twinkling, and without mental effort.



These computers are simple mechanical devices, in the nature of special circular slide rules, designed for the solution of certain more or less complicated formulas, each computer solving but the one formula (or in some special cases two) to which it is adapted. They are in this respect unlike the ordinary slide rule which is, in a sense, a universal instrument. On the other hand, the slide rule covers only operations involving multiplication, division, squares, and square roots and their combinations, while these instruments can be made to handle any powers or roots or trigonometrical functions. Problems involving more than four factors, when solved by the slide rule, must be attacked piecemeal, whereas these computers may be made to solve at once problems containing any number of factors.

They are provided with different logarithmic scales, similar to those on the slide rule, but with the important difference that each scale represents one definite factor in the formula, and is made sufficiently long to cover all probable values of that factor, so that positive quantities as 8, 80, 800, &c., are read off without chance of error, thus overcoming the slide rule difficulty of locating the decimal point.

In their simplest form the computers consist of a foundation plate in the centre of which a disc revolves. If the formula contains four factors, the scales representing two of them are placed around the upper and lower edges of the disc, the other two being similarly placed on the plate. When there are five or six factors in the formula, an extra piece of segmental shape revolves between the disc and the plate, and on this piece are laid off two more scales. All these are arranged and combined so that the values of the known factors can be placed opposite each other, when the value of the unknown one, or the solution of the problem, is at once read off.

* To be presented at the New York meeting (December, 1896) of the American Society of Mechanical Engineers, and forming part of Volume XVIII. of the *Transactions*.

The material used is the best Bristol board, the foundation plate being often attached to a board of wood or other strong material. Small computers are often put up in cloth or leather cases. The sizes vary from $4\frac{1}{4} \times 5\frac{3}{4}$ to 12×14 inches, the larger ones being more suitable for the draughting-room or office.

One important feature which adds considerably to the value of the computers is that in problems of which many solutions are possible, all the solutions are given at once, and may be read off from the contiguous scales. This feature is well illustrated in the Strength of Gears Computer, described more at length below, which gives at once all possible combinations of pitch and face which will transmit the load, so that all that has to be done is to select suitable values for each; whereas, when solving the formula arithmetically the value of one must be assumed, from which the other is then calculated. This advantage is also illustrated by the Strength of Beams Computer, in which the scales of breadth and depth, which are contiguous, show at once all possible combinations of these, from which suitable values may be at once selected.

In laying out these instruments no attempt is made to decide upon the values of constants about which authorities differ, or which involve individual experience in selection for particular cases. For such constants a special scale is provided, covering all probable values, from which the user selects the one which accords with his judgment, precisely as though he were solving the formula in the usual manner.

As to their degree of reliability, much depends upon their size, the larger ones being, of course, more adapted to close and careful work. With such, the average error will not exceed 1 per cent. In some cases where the scales are large and open this becomes reduced to $\frac{1}{5}$ of 1 per cent. But as such decimal refinements do not in practice enter into sizes of pipes, dimensions of beams, &c., the computers can be relied upon to solve their respective formulas within all needed limits.

Computers have been made to solve some fifty different formulas of which the Strength of Gears Computer may be taken as an example, see figure.

A formula much employed to ascertain the strength of gears is

$$w = c\,p\,f,$$

which may be made to read

$$\text{H P.} = c\,\frac{p \times f \times d \times r}{126{,}050}$$

in which

w = working load in pounds,
p = circumferential pitch in inches,
f = width of face in inches,
d = diameter on pitch line in inches,
r = revolutions per minute,
c = a coefficient representing the safe working pressure exerted on the teeth of a wheel 1 inch pitch and 1 inch face. The coefficient, c, is one which, as stated above, is not determined in the design of the computer; but a scale ranging between 100 and 1,000 is provided, from which the user of the computer makes a selection in accordance with the kind of tooth, material, workmanship, speed, or his own judgment.

The Strength of Gears Computer solves the above formula, and the manner of using it is as follows:—

To Find the Horse-Power a Gear will Transmit.

1. Set the face of the tooth to its pitch;
2. Bring the pitch diameter to the revolutions of the gear:
3. Opposite the selected pressure coefficient find the H.P. the gear will transmit.

To Find the Pitch and Face of Tooth to Transmit a given Horse-Power.

1. Select a pressure coefficient and place it opposite the given horse-power.
2. Hold the disc and set the segment to bring the revolutions opposite the diameter.
3. Find the required pitch opposite the face which goes with it. All coinciding lines of face and pitch scales give teeth of the same strength, and from them a tooth having the desired ratio of face to pitch may be selected.

The strength of gears computers is shown in the engraving, set for the solution of the following problem:—

Required the dimensions of the teeth of a gear 24 inches diameter to transit 40 H.P. at 70 revolutions:

Assume $c = 200$.

Set 200 at the pressure coefficient scale opposite 40 of the horse-power scale. Set 70 of the revolution scale opposite 24 of the diameter scale.

Now we find, coinciding with one another on their respective scales:

Face	... ...	5 inches,	6 inches,	$7\frac{1}{2}$ inches } &c.
Pitch	... ...	3 „	$2\frac{1}{2}$ „	2 „ }

All of which will do the work required, and from which a selection may be made.

We also see that the same power would be transmitted by the same tooth on gears of the following diameters and speeds:

Diameter	... ...	14 inches,	16 inches,	28 inches } &c.
Revolutions per minute		120	105	60 }

These results illustrate the advantage of the instrument over arithmetical computation in setting before the eye at once all possible solutions of the problem.

On the lower edge of the disc an arrow labelled "velocity" will be seen, from which we see at once that the velocity at the pitch line is 440 feet per minute, the figures of the revolutions scale, for this purpose, reading as feet.

STEAM ENGINE ECONOMY.

We commented recently on the *Engineer's* remarks anent Mr. Donkin's translation of certain experiments by M. Dwelshauvers Dery on jackets and superheating. Our contemporary thought the occasion was suitable for again demanding that steam engines are mysterious beings acting under no law. M. Dery does not seem to agree with this old womanish view of things, and he writes an interesting letter on the question, from which we abstract the following figures as being particularly instructive. The figures are the averages he obtained at the several trials:—

	Deg. Cent.
1. Temperature of saturation of the steam in the boiler before superheating	155
2. Temperature of the steam at the end of the superheater	265
3. Temperature of the steam on leaving the superheater ...	247
4. Temperature of the steam on entering the steam chest ...	199
5. Temperature of the steam in the steam pipe, after the admission valve	166
6. Temperature of the steam in the cylinder—maximum pressure from the diagrams	152
7. Temperature of the steam in the cylinder at the end of admission	145
8. Temperature of the steam in the exhaust steam chest ...	50
9. Temperature of the steam at the end of the exhaust pipe, near the condenser	43
10. Temperature of the steam in the condenser	38·5
11. Temperature of the water leaving the air-pump	31
1a. Temperature of the steam in the pipe feeding the jackets	165
2a. Temperature of the steam in the jackets—temperature of saturation	155

These figures show that with a superheat of 105° C. at the leaving end of the superheater, only 11° C. were left after the admission valve, and the steam was 10° below saturation temperature at the point of cut off. It is thus very certain that the steam had lost nearly all its superheat before it entered the cylinder. Superheat does not represent much actual heat because of the low sp. heat of steam. The figures show, at least, that the steam was *dry* when it entered the cylinder and not dry at cut off. Clearly then some of its heat had been abstracted by the cylinder walls. We are assuming that the temperature of 145° is that corresponding with the pressure at cut off, which we may fairly assume was somewhat below admission pressure. Yet in the face of this M. Dery is himself surprised that with this so-called superheated steam he secured an economy when he used the jackets also. Frankly, we cannot see where the difficulty arises. The figures in the table show that for a certain time the steam in the cylinder has a temperature of only 38·5°, or shall we rather say 50°, the smaller figure being condenser temperature only, albeit, however, the higher temperature of the steam in the cylinder probably indicates some superheat by radiation from the cylinder walls. However this may be, there is the fact that the cylinder wall must be colder than the initial steam, and colder than the jacket. If, therefore, the cylinder be jacketed, it will be made hotter and will condense less of the initial steam or will demand a smaller reduction of the superheat to raise its walls to steam temperature. Superheating by itself represents so small an addition of heat that the jacket may very well be employed, especially where as in the engine in question, the superheat was little more than an assurance of dryness. But the figures emphasise yet another point. If the superheat is so quickly reduced as these figures seem to show, are we not at liberty to assume that all steam in travelling an equal distance loses an equal amount of heat. Obviously the loss cannot be shown by a thermometer, for the temperature of wet steam must always represent its pressure. But if the heat goes, there must be a lot of water formed, and undoubtedly in all engines using saturated steam there must be a great deal of water present in the initial steam, and such being the case, it follows that superheaters are more needful than most people imagine. The rapid loss of superheat also indicates that excessive superheat is not very likely to reach the engine, and is less liable to cause trouble than has been supposed.

It has been said with truth that steam superheated and let down is apt to be a good deal dryer than steam that has been simply made in the ordinary manner. Steam let down to saturation temperature we do know to have been once perfectly dry, but saturated steam we know never has been strictly dry, an assumption borne out by Fairbairn's observation, that steam rose rapidly in pressure when superheated the first few degrees, and after that only increased like other gases, so proving the presence of water as water and not as steam in a bulk of saturated steam. M. Dery in his paper spoke of draining the steam chest even when using superheated steam. He explains this by supposing dead corners to exist in which condensation can occur.

The only point requiring certain elucidation is the observed smaller initial condensation when the steam chest was not drained than when it was drained, and M. Dery promises a second paper on the subject, when he will deal with this and similar points.

BOILER HORSE-POWER.

A discussion now proceeding in the pages of *Machinery* (New York), shows the mistake that is made in attempting to fix upon a unit of any kind, unless the same has an absolute meaning. In the horse-power we have an absolute unit, and the horse-power has per con-

sequence become a very general unit, for not only the steam engine to which Watt first applied it, but to water motors, and all manner of machinery, both prime movers and secondary, as well as mere power absorbers. But boilers have been rated per horse-power in the same way as engines were once rated at per nominal horse-power, and what was in our young days a nominal 40 horse boiler, would now be expected to drive 10 times that power of engine. In America in 1876 the Centennial Exhibition authorities defined a boiler horse-power as a capacity to evaporate so many units of water, the unit being 30 lbs. per hour. As a unit this was not a bad one, but, unfortunately, it was correlated with the mechanical absolute unit and called a horse-power, so that for a modern compound or triple engine the Centennial unit is utterly meaningless and even mischievous. A writer in *Machinery* condemns the use of the term horse-power in rating boilers. He says there is no justification for appropriating the name of a universally accepted standard and applying it to another unit whose usefulness is questionable. He asks of what use is it even to have a unit whereby to designate a boiler. How, then, ought one to define the conditions under which a boiler should work and demand a guarantee that the boiler shall fulfil the named conditions. With such varying items as grate surface, heating surface, quality of fuel, draft, and all that goes to form the general environment and *régime* of a steam boiler, it is obviously impossible to fix upon any specific unit of description. If fixed upon it would be useless to the layman who could not apply it with sufficient technical knowledge, and the professional man would not use it, for he would always work on general principles, and want to know the broad main facts, such as grate surface, length and diameter, and the unit would be useless after all. The craze for brevity seems to be at the bottom of the desire to state the whole facts of a boiler in a single figure. It can be done neither with engines or boilers, for in engines with the same cylinders the speed and pressure, or cut-off point, all have their share in determining the duty that can be done.

The writer above-named finds similar fault with the confusion of the terms, degree of temperature, and heat unit. Thus people will speak of degrees of heat. This is entirely improper; a degree of temperature is a statement of the head, and is comparable to the head of water in a hydraulic sense. A unit of heat is simply so much heat independent entirely of temperature, and is used to state the quantity of heat in a given bulk of a certain body, and there may be more heat in a cold body than in a hotter body of equal weight, according to the respective capacities of the two substances. The degree cannot be made to measure the amount of heat any more than the depth of a fluid can be taken alone as a measure of its volume.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1896.

[*Compiled expressly for this journal by* W. P. THOMPSON & Co., *Electrical Patent Agents, 322, High Holborn, London, W.C., to whom all inquiries should be addressed.*]

23,942A. "Improvements in electric switches." R. BELFIELD. (A. J. Wurts, United States.) Dated November 27th. (Date claimed under Patents, Rule 19, October 27th, 1896.)

26,427. "Improvements in electrical switches." R. BRYMER and J. TODD. Dated November 23rd.

26,452. "Improvements in electric storage batteries." P. L. NORRINGTON. Dated November 23rd.

26,470. "Improvements in electrical reversing switches." T. W. TAYLOR. Dated November 23rd.

26,539. "Application of electricity for the thawing off of ice from cells and plates of refrigerating apparatus." S. T. PARRY. Dated November 24th.

26,546. "Improvements in motor carriages and the adaptation of same to electrical advertising." E. SANDOW and A. G. ADAMSON. Dated November 24th.

26,565. "Electric lighting of bicycles, motor cars, &c." I. M. SUTHERST. Dated November 24th.

26,583. "Improvements in rail bonds for electric railways." V. B. D. COOPER, A. J. LAWSON and S. P. W. D'ALTE SELLON. Dated November 24th.

26,597. "Improvements in and connected with joints and junctions for electrical conductors and conduits." C. R. G. SMYTHE. Dated November 24th.

26,598. "Improvements in apparatus for preventing accidents by electrical tramcars." K. PUSKAS. Dated November 24th.

26,627. "Improvements in or relating to alternating current systems of distribution and regulation." R. BELFIELD. (B. G. Lamme and R. D. Mershon, United States.) Dated November 24th.

26,677. "Improvements in electric switches for use in connection with electrically propelled vehicles and locomotives and for other purposes." A. T. SNELL, C. E. GROVE and A. F. HILLS. Dated November 24th.

26,737. "Improvements in and relating to electric batteries." H. FEWSON. Dated November 25th.

26,742. "Improvements in the construction and manufacture of spring jack switches used in telephonic switchboards." D. SINCLAIR and F. A. S. WORMULL. Dated November 25th.

26,774. "Improvements in conduit pipes for electric conductors." H. EDMUNDS. Dated November 25th.

26,776. "Improvements in devices for protecting electrical instruments or machinery from the effects of lightning or excessive voltage. G. KEMP and E. MIDDLEMISS. Dated November 25th.

26,811. "An improved method or means for the conversion of alternating into continuous or unidirectional currents." F. M. LEWIS and B. P. SCATTERGOOD. Dated November 26th.

26,828. "Improvements in electric accumulators or storage batteries and primary batteries." J. D. BELL. Dated November 26th.

26,846. "Improvements in electric bell pushes or knobs." T. SANDERS. Dated November 26th.

26,864. "An improved continuous current machine operating by induction." M. BRAB. Dated November 26th. (*Complete.*)

26,896. "Improvements in and relating to machines for printing on cylindrical bodies such as tumblers, electrical bulbs, lamp chimneys and the like." C. H. BUNTING. Dated November 26th. (*Complete.*)

26,911. "An automatic current and potential regulator." NEW AND MAYNE, LIMITED. Dated November 27th.

26,947. "Improvements in electrical switches." M. BYNG and F. G. BELL. Dated November 27th.

26,965. "Improvements in means or apparatus for use in electrically lighting incandescent and other gas burners." F. R. BOARDMAN. Dated November 27th.

26,968. "Improvements in the construction of spring jacks used in telephonic switchboards." D. SINCLAIR and W. AITKEN. Dated November 27th.

26,969. "Improvements in frames for holding finely divided mass such as the active material of electric accumulators." W. HOLZAPFEL. Dated November 27th. (*Complete.*)

26,982. "The sea-saw switch system." R. C. JEBOULT, J. R. BILLINGS and H. G. ELLIS. Dated November 27th.

27,041. "Improvements in conduits for gas pipes, electric wires or cables, and other analogous purposes." W. SAYER. Dated November 28th.

27,047. "Improvements in or connected with electric cable disconnecting boxes." G. H. NISBETT and W. BOBY. Dated November 28th. (*Complete.*)

27,048. "An improved combined electric and hydraulic lift." P. R. J. WILLIS. (J. Parkinson, United States.) Dated November 28th.

27,049. "An improved combined electric and hydraulic elevator." P. R. J. WILLIS. (J. Parkinson, United States.) Dated November 28th.

27,053. "A new or improved insulator device for carrying vertical or similarly suspended electric cables." R. HOLIDAY. Dated November 28th.

27,128. "Improvements in electric tramways and railways." H. H. LAKE. (R. Arno and A. Caramagana, Italy). Dated November 28th. (*Complete.*)

27,131. "Improvements in electrical apparatus for signalling to and from railway trains and locomotives." R. BURN, A. C. BROWN, and L. G. TATE. Dated November 28th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

[*Copies of any of these Specifications may be obtained of* Messrs. W. P. THOMPSON & Co., 322, High Holborn, W.C., *price, post free,* 8½*d. (in stamps).*]

1895.

13,014. "Improvements in dynamos and electric motors, the invention being particularly applicable to motors carried in the rudders of vessels. A. G. NEW and A. J. MAYNE. Dated July 5th, 1895. Relates more particularly to motors carried in the rudders of vessels and having a stationary armature and rotating field magnets. The commutator is arranged at a distance from the armature and is provided with revolving brushes, and carried in a holder, to which motion is communicated from the axle through bevel gearing and a spindle. Current is supplied through stationary brushes which bear on rings in connection with the revolving brushes. 1 claim.

1896.

1,054. "Improvements in voltaic batteries." D. G. FITZGERALD and W. C. BERSEY. Dated January 15th, 1896. Combines with sulphuric acid in a secondary voltaic cell a silicious material such as Tripoli stone, pumice stone, or porous earthenware, separately or together, as a mechanical absorbent for the electrolyte, and as a packing for preventing the buckling of the plates and shedding of active material. 3 claims.

1,744. "Improvements in electric traction." DÉSIRÉ KORDA. Dated January 24th, 1896. Relates to electric traction by polyphase currents and consists in employing an inductor or field forming part of the permanent way and part or armature induced thereby which is attached to the vehicle in such a manner that movement is given to the vehicle by a direct propulsion due to the action of the magnetic field of the fixed inductor on the part induced. 4 claims.

2,915. "An improved electric gas igniting and extinguishing apparatus." A. CZARNIKOW. Dated February 8th, 1896. On closing one of two separate currents a contact is opened, sparking is caused, and an armature interpolated in the second current circuit released whereby a valve automatically opens. The extinguishing of the flame is effected upon the closing of the second current circuit by the armature pressing the valve again upon its seat. 3 claims.